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IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF ILLINOIS  
EASTERN DIVISION

THE UNITED STATES OF AMERICA, )  
 )  
Plaintiff, )  
 )  
vs. ) No. 78 C 1004  
 )  
OUTBOARD MARINE CORPORATION )  
and MONSANTO COMPANY, )  
 )  
Defendants. )

The deposition of DR. DAVID STALLING, called by the Defendant Monsanto Company for examination, pursuant to notice and agreement and pursuant to the Rules of Civil Procedure for the United States District Courts pertaining to the taking of depositions, taken before Jean Korinko Sweeney, a Notary Public in and for the County of Cook, State of Illinois, and a Certified Shorthand Reporter of said state, at the United States Attorney's Office, 219 South Dearborn Street, Room 1400, Conference Room, Chicago, Illinois 60604, on the 9th day of September, A.D. 19 82, commencing at ten o'clock a.m.

PRESENT:

MR. JAMES WHITE,  
(Assistant United States Attorney,  
United States Attorney's Office  
219 South Dearborn Street,  
15th floor, Chicago, Illinois 60604),

Thos L. Urban  
Court Reporter  
1518.06

-and-

MR. JERROLD H. FRUMM,  
(Enforcement Division,  
U.S. Environmental Protection Agency  
230 South Dearborn Street,  
Chicago, Illinois 60604),

appeared on behalf of the United States of  
America;

MR. MICHAEL A. POPE and  
MS. ROSEANN OLIVER  
(Phelan, Pope & John, Ltd.  
180 North Wacker Drive,  
Chicago, Illinois)

-and-

MR. RICHARD J. KISSEL and  
MR. JEFFREY C. FORT,  
(Martin, Craig, Chester & Sonnenschein  
115 South LaSalle Street  
Chicago, Illinois 60603),

appeared on behalf of Outboard Marine  
Corporation;

MR. BRUCE A. FEATHERSTONE,  
(Kirkland & Ellis  
200 East Randolph Drive,  
Chicago, Illinois 60601),

appeared on behalf of Monsanto Company.

ALSO PRESENT:

MR. HUGH THOMAS,  
MR. MARK SCHNEIDER,  
MR. JOHN VAN VRANKEN,  
MR. FRED D. HILEMAN,  
MR. RICHARD YOUNG.

\* \* \* \* \*

Ther L Urban  
Chief of Staff and Personnel  
115 South LaSalle Street  
Chicago, Illinois 60601  
312-526-1111

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MR. FEATHERSTONE: Would you swear the witness in, please.

(Witness duly sworn.)

DR. DAVID STALLING,

called as a witness by the Defendant Monsanto Company  
for examination, having been first duly sworn, was  
examined and testified as follows:

## DIRECT EXAMINATION

BY MR. FEATHERSTONE:

Q Are you Dr. David Stalling?

A That is correct.

Q Are you employed by the United States Government?

A Yes, sir.

Q For how long have you been employed by the United States Government?

**A** Since May 20, 1968.

Q Did you graduate from school in May of 1968?

**A      No.**

Q Have you ever held any employment other than with the United States Government?

A Yes, sir.

Q Where and for how long?

A Prior to joining the Fish and Wildlife

THE LIFE OF  
CHRISTOPHER COLUMBUS  
BY  
JAMES H. COOPER

Stalling - direct (Featherstone)

Service I worked as an instructor at the University of Missouri from about 1963 to 1967 -- until 1968.

Prior to that I was employed in demolition and construction with my father, with a construction firm in Kansas City.

Q When you were an instructor at the University of Missouri, did you do any government-funded research?

A Yes, sir.

Q Was this research funded by the United States Government?

A Yes, sir.

Q Did you do government-sponsored research throughout the period 1963 to 1968?

A Yes, sir.

Q Can you tell us approximately how much of your research during that period, 1963 to 1968, was paid for by the Federal Government?

MR. WHITE: Are you asking for a percentage, Bruce?

MR. FEATHERSTONE: Any way he can approximate it.

BY THE WITNESS:

A I would say in excess, slightly in excess

Thos L. Urban  
Certified Shorthand Reporter  
100 S. 4th St., Suite 100  
Chicago, Ill. 60604

Stalling - direct (Featherstone)

of 50 percent, but probably -- Let me reflect a moment.  
Between 30 and 50 percent.

BY MR. FEATHERSTONE:

Q Was the rest of the research you did funded  
by private sources?

A From -- No.

Q Funded by the University?

A Yes. I might correct that. A portion of it  
was funded by private industry.

Q How large a portion of research you did from  
1963 to 1968 was paid for by private industry?

A I would say five percent or thereabouts.

Q The work that you have recently done concern-  
ing samples from Waukegan Harbor, was that paid for by  
the United States EPA?

A I am afraid I cannot answer the question.  
I would refer you to Mr. Hynes or the attorneys for  
source of funding.

Q Are you aware whether the funding for the  
research you have recently done concerning samples  
from Waukegan Harbor was paid for by funds other than  
the normal funding for your laboratory?

A Yes.

Thos L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60604

Stalling - direct (Featherstone)

Q It was?

A Yes.

Q You have to answer audibly.

A Yes, yes, it was.

Q Do you know the cost of the research you have recently done on samples from Waukegan Harbor?

A Approximately \$4,000 direct cost, and some compensation in regard to travel funds.

Q When you say direct costs, does that include your time?

A Yes.

Q Is the time that you will be spending testifying in this case also being paid for by sources other than your laboratory?

A That is my understanding.

Q Do you know who is paying for that testimony?

A I assume the source of funds is from the attorney's office. But again, I am not certain of the actual source of money.

Q Is the time that you are spending testifying being paid for on a daily basis or hourly basis, do you know?

Stalling - direct (Featherstone)

A I assume it will be paid on the basis of hour, yes, hourly rate.

Q Do you know what that hourly rate is?

A I do not, other than it's the normal salary that I would receive.

Q You mean your normal salary, pro-rated on an hourly basis?

A That is correct.

Q The work that you have done generally at the laboratory, your laboratory, from when you joined in 1968 to day, is some of that research generally paid for by monies other than the normal funding for the laboratory?

A No.

Would you restate your question again.

Q Sure. From say 1975 through today, have you done other research that has been paid for by US EPA?

A Yes, we did.

Q Can you give me any approximation of the amount of research that you have done from 1975 through today that has been paid for by US EPA?

A Yes.

Theo L. Urban  
Certified Shorthand Reporter  
20 South La Salle Street



## Stalling - direct (Featherstone)

Q What is that?

A I would say less than five percent of our effort.

Q Can you tell me what that is in dollars?

A I could approximate it being less than \$30,000 to \$50,000 over the course of three or four years.

Q Is that your personal research?

A No.

Q Or that of your laboratory?

A No, it is not my personal research. It would be part of the laboratory.

To simply clarify, as part of the laboratory there are other projects which I am not involved in that interact with the EPA.

Q You mean that are funded by the US EPA?

A That is correct, which I would not be part to.

Q Those projects that you would not be involved in, but which would be handled by the laboratory in which you work, you do not include those in the \$30 to \$50,000 figure?

A That is correct.

Ther L. Urban  
Chief of Staff and Director  
U.S. Environmental Protection Agency

## Stalling - direct (Featherstone)

Q Do you have any idea of the total US EPA funding of work at your laboratory from 1975 to 1982?

A I could guess at it.

Q Is your guess a reasonable approximation?

A I would guess yes.

Q So would you tell me what it is.

A I would say between \$500 and \$600,000.

Q Have you ever testified before for the United States Government on matters relating to PCBs?

A Yes.

Q How many times?

A I think one time specifically dealing with PCBs.

Q What PCB situation was this?

A In the case where New York -- pollution of the Hudson River.

Q Was this the lawsuit that was brought by the State of New York against General Electric?

A That is correct.

Q Was your testimony in the mid-1970s?

A Yes.

Q What did you testify about?

A At that point the testimony covered the

Thea L. Urban  
Certified Shorthand Reporter  
100 South La Salle Street

Stalling - direct (Featherstone)

occurrence of PCBs in fish from the Hudson River. It touched on accumulation of PCBs in fish from laboratory studies, and a limited amount of toxicology information, and also on analytical methodology employed for PCB analysis.

Q Have you ever been asked by the United States Government to testify in any other proceeding concerning PCBs, other than the one you are testifying in today?

A No.

Q Have you ever given any testimony before any Congressional committee about PCBs?

A No.

Q Have you ever submitted any papers or affidavits to any Congressional committee, or any US EPA hearing?

A You have two questions. As far as I know, submission of documents to Congressional hearings, I have not. As far as EPA proceedings, if you will clarify your question there a little bit, I might answer it more appropriately.

Q Well, have you ever submitted an affidavit or a paper for use in a US EPA hearing?

A I think I would answer yes to that question.

Ther L Urban  
Cent Fed Street and  
1000 10th St, N.W.  
Washington, D.C. 20004

Stalling - direct (Featherstone)

We have dealt with PCBs -- let's see, with DDE, DDT cancellations in the early 1970s. There was participation in an administrative hearing, I believe it was, with the EPA on the cancellation of DDT. I was involved with Judge Sweeney's review of that case, or provided information on the occurrence analysis of DDT.

Q Did that information that you provided include in any way PCBs?

A Not at that time.

Q Have you ever submitted anything to the US EPA in connection with a hearing or proceeding concerning PCBs?

A That is a difficult question to answer, because we have corresponded with EPA on PCB analysis and occurrence of PCBs in fish. Whether that information is used in hearings, I would not directly know.

Q Have you ever testified anyplace concerning dibenzofurans?

A In terms of formal testimony such as we are doing today, no.

Q With that limitation there must be something in your mind that caused you to limit it that way.

Thos L. Urban  
Certified Steno and Reporter  
100 S. H. 100 S. H.

## Stalling - direct (Featherstone)

Where have you made statements that while you don't consider it formal testimony, came close to that?

A Well, we have presented information concerning the analysis and methodology employed for furans and dioxins at numerous scientific meetings, and I have had discussions with the Environmental Protection Agency's office on toxic substances and the occurrence of dibenzofurans and dioxins in the aquatic organisms.

Q Did your laboratory do any work concerning Waukegan Harbor before November, 1981?

A I am not certain about the dates. We did do an analysis of some fish samples from Waukegan for dibenzofurans and dioxins. Other than that one sample, and the sample currently submitted for analysis, we have not done other analysis.

Q So the first work that you or your laboratory did concerning the two fish samples from Waukegan was where you looked for dioxins and dibenzofurans, is that correct?

A Yes.

MR. FEATHERSTONE: Would you mark this as Exhibit 1.

Theo L. Urban  
Certified Shorthand Reporter

Stalling - direct (Featherstone)

(Said document was marked Stalling  
Deposition Exhibit No. 1 (Monsanto)  
for identification, as of 9/9/82, JKS.)

BY MR. FEATHERSTONE:

Q I have marked as Exhibit 1 to your deposition, Dr. Stalling, a four-page document. Is that the document that reports on the analysis your laboratory did for dibenzofurans and dioxins in Waukegan Harbor fish?

A Yes, it is.

Q Is that the first work that your laboratory did concerning Waukegan Harbor, is that right?

A To the best of my knowledge, yes.

Q Did you personally participate in the analytical work that was done and is reported in Exhibit 1?

A Yes, I did.

Q What did you do?

A Reviewed analysis in the mass spectrometry results, and reviewed some of the calculations involved, and wrote the report that is provided as a transmittal letter to the EPA.

Q When you say the report that is a transmittal

Ther L Urban  
Certified Shorthand Reporter  
766 S. W. 10th St., Miami, Fla.

Stalling - direct (Featherstone)

to the US EPA, you are referring to something other than Exhibit 1?

A There was a cover memo which transmits this information.

Q Did you write what is now Exhibit 1?

A Yes. Well, let me see for sure about that.

No, I did not type this memo. That was done in the steno pool, and Larry Smith authored or summarized the results. We had reviewed it before he put it in the table or tabulator form.

Q Did you personally review the chromatograms?

A Yes, I did.

Q Did you personally check to make sure that the chromatograms matched the data that are shown on pages 2 and 3 of the exhibit?

A Yes, I did.

Q Did you also participate in the quantitation of the PCBs, dioxins and dibenzofurans that are reported in Exhibit 1?

A I did not do the physical measurements from the computer system, other than I did review the information before it was finalized.

Q Well, who did the physical measurements of

Thos L. Utter  
Chief of Steno and Dictation  
U.S. EPA, Las Vegas  
March 11, 1977

## Stalling - direct (Featherstone)

the PCBs, dibenzofurans and dioxins that were found in the fish samples?

A Mr. Larry Smith and Mr. Jim Johnson are charged with the operation and maintenance of the sample preparation and analysis.

Q Did they do the measurements then?

A They did the -- Larry Smith did the sample preparation and Jim Johnson made the injections on the gas chromatogram mass spectrometer and acquired the data.

Q To the extent you were involved, you took a look at the data to make sure it made sense to the best of your understanding?

A That is correct.

Q You did not physically go back and review the chromatograms or do the quantitation?

A Earlier I stated I reviewed the chromatograms.

Q But you did not do the quantitation?

A That is correct.

Q Is any of the data listed on pages 2 and 3 of Exhibit 1 incorrect in any way?

A To the best of my knowledge, it is correct.

Q Who selected the samples that were analyzed

Theo L. Urban  
Certified Short and Peculiar  
174 South 1st Street



## Stalling - direct (Featherstone)

and that are reported in Exhibit 1?

A I do not know.

Q To your knowledge did your laboratory have any input whatsoever in the selection of those two samples?

A No, they did not.

Q Were these samples furnished by US EPA?

A That is correct.

Q Were you involved in any discussions with US EPA about this project before the analysis was run by your laboratory?

A Only in the following way. My memory is a little bit vague, but we were contacted in terms of the possibility of doing analyses. I believe the initial contact was made by Dr. Veith at the Duluth EPA Laboratory, inquiring as to whether it would be feasible to make these measurements, and then following that discussion, if memory serves me correctly, Mr. Ross at the EPA Laboratory contacted me, or I contacted him, I cannot remember that, and we were then given or sent two samples for analysis, as part of a national survey we were undertaking for the occurrence of dibenzofurans and dioxins.

Ther L Urban  
Certified Steno and Reporter  
135 South 1st St. Suite 100  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

Q It was your decision not to put the quality control information in Exhibit 1?

A It was not intentionally done. Yes, it was my decision not to. Not consciously, let me say that. It was not my decision not to include it. I just did not include it, since we were not asked for any other information other than the content of the samples.

Q You testified just a moment ago that you had a conversation with Dr. Veith about the two samples that were analyzed and reported in Exhibit 1, correct?

A That is correct.

Q Did Dr. Veith tell you that during that conversation that he had looked for dibenzofurans in the Waukegan Harbor and failed to find any?

A No, he did not.

Q Did you ever learn that?

A No.

Q Have you ever seen the report in which Dr. Veith said that?

A No, I have not.

Q Is your work concerning Waukegan Harbor complete?

Thos L Urban  
Certified Forensic Chemist  
100 S. 11th St., Chicago

## Stalling - direct (Featherstone)

Are you done?

A Insofar as meeting the direct objectives that we were asked to do in the analyses, we have I think completed the work. To say we might not take a second look, or further work in the future, would depend on our curiosity.

Q Do you have any present intention to take a look at any further samples from Waukegan Harbor?

A I haven't made my mind up.

Q Have you been asked to do so by the United States Government in this litigation?

A No.

Q Is there a proposal to do further work in Waukegan Harbor?

A Not so far as I know.

Q Have you had discussions with people in your laboratory about doing so?

A No.

Q I see. So that to the extent that there is any present intention to do any further work, it is some embryonic thought in your brain, is that correct?

A It might be.

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Ill.

Stalling - direct (Featherstone)

MR. FEATHERSTONE: Would you mark this as Exhibit 2.

(Said document was marked Stalling  
Deposition Exhibit No. 2 (Monsanto)  
for identification as of 9/9/82, JKS.)

BY MR. FEATHERSTONE:

Q Dr. Stalling, I hand you a document marked as Exhibit 2 to your deposition. What is Exhibit 2?

A You are asking me?

Q Yes.

A It is the report of the analysis pertaining to the samples supplied by EPA, to our laboratory by EPA which I received, and delineates the quantitation and analytical methodology employed in generating the data.

Q Exhibit 2 contains both a short report and then four appendices, is that correct?

A That is correct.

Q Is that the entire report?

A Yes, it is.

Q Did you or your laboratory have any involvement in selecting the samples --

A No.

Theo L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

Q -- to be analyzed?

A We did not.

Q The US EPA told you what samples to take a look at?

A They supplied the samples.

Q Did you or your laboratory participate in any way in deciding what samples were to be analyzed and reported in Exhibit 2?

A No, we did not.

Q Well, for instance, did you or your laboratory say that you wanted five or six fish samples, for instance?

A I think the conversation on the topic of samples were that five or six samples would be available, and that it was up to the EPA group to supply samples in terms of what was available for analyses in relationship.

Other than very, very, very indirect conversation on the composition of the samples, we had no direct input on formulating, other than what we could analyze within the time frame we were asked to work in in terms of numbers of samples.

MS. OLIVER: Would you read the answer back, please.

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Stalling - direct (Featherstone)

(Record read.)

BY MR. FEATHERSTONE:

Q Let me make sure I understand that, Dr. Stalling. What you are saying, basically, is that US EPA told you that they were going to send six or seven samples, and you stated that in the time frame or the time period that you were given you could analyze those six or seven samples, is that right?

A Essentially we said we could analyze approximately ten to twelve samples total. That what the composition of the samples would be was not a decision we were going to make, or were asked to make.

Q What was the time period you had in which to analyze the samples?

A I have to go from approximate memory. We had approximately two months. That is the best -- I would have to check laboratory records to give you more exact time when we received the samples.

Q There is a page in your report that talks about sample description and origins, do you see that?

A Yes, sir.

Q On that page there are listed seven samples by EPA number that are termed fish samples, do you see that?

Thos L Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
Chicago, Ill.

## Stalling - direct (Featherstone)

A Yes.

Q Doctor, you have to answer audibly.

A Yes, I see that.

Q Do you know the species of fish in any one of those samples?

A I reviewed the composition of these samples very briefly with Ms. Stein, and from recollection there is Coho salmon, there is whitefish, a perch, a bullhead, a catfish group, and beyond that I cannot recall.

Q You did not set out the particular species of fish involved in your description of the various samples that were given to you. Do I take from that that the particular species involved is not important to your data?

A We were not -- The answer to your question is the species important, in terms of PCB composition, the species is probably a minor consideration.

Q Does that also hold true for dibenzofurans and dioxin analysis?

A Yes.

Q With respect to any of the opinions that you have regarding what your data shows, is the

Ther L. Urban  
Gen. Sec. St. and Reg. Div.  
EPA, Wash., D.C.

## Stalling - direct (Featherstone)

species of fish involved important?

A No.

Q Did you make any effort to look for dibenzofurans in any of the fish samples or sediment samples that are reported in Exhibit 2?

A No, we did not.

Q Is that because you did not have enough time to do that?

A That is correct. And I would add, we also had some people on vacation during that period of time, which would relate to time available. We did not have all the people in the laboratory available for the analysis.

Q In the fish and sediment samples reported in Exhibit 2, did you look for all types of non-ortho PCBs?

A Yes.

Q What was your involvement in the work that is now reported in Exhibit 2?

A I will try to be as exact as I can. The analytical system as described in the report, I received the samples from the transportation system that brought the samples to our laboratory, along with the documents for chain of custody. The samples, I placed

Thos L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60607



## Stalling - direct (Featherstone)

in the freezer, and we discussed the laboratory number assignment with Mr. Ted Schwartz.

Q Who is he?

A He is the analyst that is referenced in this report in page 1 or 2.

Q He is in your laboratory?

A He is a chemist in our laboratory, yes, in the chemistry section, and has worked with me for the last four years regarding PCB analysis, or longer.

Following the sample receipt, we set out a protocol for the analysis of the samples, which is set forth in the description of the methodology.

Q Were you personally involved in that?

A In the protocol?

Q Yes.

A Yes, I was.

Q Please continue.

A Following the receipt of the samples, and the organization of the effort for the analysis, the plan, I calibrated the instrumentation involved in the measurement in the computer system, personally calibrated it and verified that it was in proper

Ther L Urban  
Certified Sheriff and Reporter  
100 S. W. 11th St.  
Chicago, Ill. 60603

## Stalling - direct (Featherstone)

working order.

Also in the analysis Mr. Schwartz was responsible for grinding, preparation of the samples. Then I reviewed the data from the integration of the computer system. I reviewed the data in the data management system. I organized the report that you have before you, prepared it. Collated all the chromatographic results following their review. I participated in the discussions on quality control, which is documented in the report, and organized, set out the analytical protocol for the non-ortho chloro measurements, reviewed the data, and collated the information, and saw that these reports were transmitted.

Q Did you personally perform the quantitation steps?

A No, I did not. That is done by computer.

Q Well, were you involved in that process?

A Yes.

Q How so?

A Through the review of the information and quality control checks on it.

Q Do you know whether the fish samples that

Theresa L. Urban  
Certified Shorthand Reporter  
100 S. 4th St., Suite 200

Stalling - direct (Featherstone)

you analyzed were taken at one time in Waukegan Harbor?

A I cannot tell you anything pertaining to the source or the collection portions of these samples.

Q That includes the sediments as well?

A Yes.

Q Does it make any difference to the opinions or inferences to be drawn from your results whether the samples were all taken on the same day, or whether they were taken years apart?

A It's immaterial that they were taken on the same day. To the extent that time is a factor, I don't know as I have an opinion on that question. If it is within a year's frame of reference, it probably is a minor consideration.

Q Did you say within one year?

A Within a year or so of the collection, it is probably a minor consideration. I really have no specific opinion on the time frame for the samples. I don't know the samples time frame.

Q I am not asking you specifically regarding those samples. I am asking you could it make a difference, as a matter of science, in drawing opinions

Ther L Urban  
Certified Shorthand Reporter  
121 S. W. 10th St.

Stalling - direct (Featherstone)

or inferences from your data, whether those samples were taken within a year period of time, or whether they were taken three or four years apart?

A It is possible it could make a difference. As far as the data per sample goes, it makes no difference. The data are what they are from that sample analysis.

Q But looking at the data across the samples it could make a difference if the period of time, if it was extended?

A I have no information over the years.

Q But do you agree with my statement?

A It is possible it could make a difference. I don't --

Q Do you know anything about the Johnson Motors facility in Waukegan?

A I do not, no.

Q Do you have any idea at what temperature or pressure the Pydraul fluids were used --

A I do not.

Q At the Johnson Motor Facility?

A No, I do not.

Q Have you asked for that information at all?

Thos L Urban  
Certified Forensic Examiner  
Illinois State Police

## Stalling - direct (Featherstone)

A No, I have not.

Q Does that type of information make any difference to any opinions that might be drawn from your data?

A Not specifically.

Q So far as you are concerned it is not important to your testimony in any way?

A Again, as far as the analysis of the sample goes, it seems irrelevant. The conclusion or the information would seem to be of little consequence as far as the data itself goes.

Q I take it because you do not have any of that information you obviously do not have an opinion as to whether or not the use of the PCB Pydraul fluids in the Johnson Motor facility in any way created dibenzofurans?

MS. OLIVER: I object for lack of foundation.

MR. FEATHERSTONE: I am just making sure he does not have an opinion on that.

BY THE WITNESS:

A I have an opinion on the interaction of the PCBs in the formation of dibenzofurans.

Thea L. Urban  
Certified Shorthand Reporter  
100 South La Salle Street  
Chicago, Illinois 60601  
TELEPHONE 312-467-1111

## Stalling - direct (Featherstone)

BY MR. FEATHERSTONE:

Q No, no. My specific question is do you have the basis for having any scientific opinion about whether or not the Johnson Motor diecast facility somehow generated dibenzofurans in the use of PCB Pydraul fluid?

A It is possible.

Q Do you have an opinion that that happened?

A Obviously the dibenzofurans are present in the samples from Waukegan Harbor, and it is a known scientific fact that PCBs can be transformed into dibensofurans.

Q Let me ask you this. Have you determined that the dibensofurans in those two fish samples that you found came from use of PCB fluids at Johnson Motors?

A No, I have not.

Q Correct me if I am wrong. You have not found dibenzofurans in any other samples from Waukegan Harbor, because you have not looked.

A That is correct.

Q Do you have enough knowledge at this time to render a scientific opinion about whether or not

Ther. J. Urban  
Capt. G. J. Stalling and Detective  
in Charge, O. C. C.

Stalling - direct (Featherstone)

the diecast process at Johnson Motors from the years 1955 through 1972 generated dibenzofurans from the PCB fluid? Do you have enough information to do that?

A If I knew the temperature of the operation.

Q But you do not know that, do you?

A I do not know that.

Q So the answer is no, you do not have the information?

A I don't have the information, but it is possible.

Q Have you requested any information that has not been given to you?

A No, I have not.

Q Did you or your laboratory propose any work for Waukegan Harbor that was not done?

A No. I think we covered that in the earlier questions.

Q Is there any work that you or your laboratory was requested to do concerning Waukegan Harbor that was not done?

A In terms of the dibenzofurans we were asked, following the initial contact, to perform the analysis, if we could do dibenzofurans. The time was not

Thos L. Urban  
Certified Standards Director  
Ill. State Police Lab.

Stalling - direct (Featherstone)

possible to do that.

Q Have you issued any other report about the samples other than what has been marked as Exhibit 2 to your deposition?

A No, in regard to the Waukegan samples.

The National Pesticide Monitoring Program samples are part of an ongoing routine analysis program in the laboratory for PCBs, and there will be data that comes from those reports sometime in the future. I mean, there are possibilities of other information, but at present there is no other report than what you have here on these samples.

Q You are referring to Exhibit 2 which is in front of you?

A Exhibit 2, right. I don't want to preclude the possibility, is what I am saying.

Q Have you ever made a study of the origin of non-ortho PCBs found in the sediments of a waterway of some sort?

A Yes, in the following way. We have examined PCBs for the presence of ortho chloro compounds. That information is summarized in this report, and with respect to the composition of the PCBs. And insofar

Ther L Urban  
Certified Chemical and Petroleum  
174 South La Salle Street  
Chicago, Illinois 60604



Stalling - direct (Featherstone)

as it pertains to what PCBs are made of, in terms of individual components, we could say that PCBs in and PCBs out, that they are a part of Aroclors, and the composition of such is set out in this report.

Q My question was a little more specific. Other than Exhibit 2, have you ever been involved in a study, the purpose of which was to determine the source of non-ortho PCBs in the sediments of a harbor or river or lake?

A I think I should answer yes. In that sense we did participate in an analytical study of PCB composition in dibenzofurans in the Housatonic River at the request of Senator Moffett. Such report was furnished to him. And also corroborated, to the information extent exchange, with the State of Connecticut, in the experimentation station there pertaining to PCBs in the Housatonic River and the distribution of PCBs from a situation or a manufacturing operation operated by General Electric at Pittsfield, Massachusetts, I believe it is.

We studied the composition similarity of residues of PCBs in fish and sediments, as well as the disproportionation of dibenzofurans in both

Ther L Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
Chicago, Illinois

## Stalling - direct (Featherstone)

sediments and fish and in vertebraes.

Q Can dibenzofurans move by atmospheric transport like PCBs?

A I am of the opinion they can, and do.

Q Are you familiar with data showing the PCB levels in fish found in the Illinois waters of Lake Michigan?

A I am familiar with PCB residues in fish from Lake Michigan, yes.

Q Are you familiar with that data over a period of years?

A Yes.

Q Has it been your observation from the data that the PCB levels in fish found in Lake Michigan are declining?

A The trends substantiate the beginning of a decline in lake trout, possibly.

Q You limited your answer to lake trout. How about chubbs, are you aware that the data has shown that PCB levels in chubbs found in Lake Michigan have declined?

A Yes.

Q Are you aware that the data for the PCB levels

Stalling - direct (Featherstone)

in perch from Lake Michigan have shown declines in PCB levels over the years?

A Yes, I am.

Q Are you aware, Dr. Stalling, that the data regarding the PCB levels in Coho and Chinook salmon show that those PCB levels have been declining over the years?

A Only to a certain extent.

Q What, you are familiar only to a certain extent?

A That they have declined. ~~The information I have reviewed has shown some decline in those species. The incidence of PCBs in the National Pesticide Monitoring Program has not, however, declined.~~ It has decreased, in terms of the overall National Pesticide Monitoring Program. More species contain PCBs than previously in that report that goes up to 1979. The data is only available to 1979.

Q The data you are referring to in the last part of your answer, however, is not limited to Lake Michigan, isn't that right?

A That is right. From the National Pesticide Monitoring Program.

Ther L. Urban  
Chief of Fisheries Research  
U.S. Fish and Wildlife Service  
Washington, D.C.

## Stalling - direct (Featherstone)

Q My question concerns PCB levels in fish in Lake Michigan. Are you aware that the data for the PCB levels in Coho salmon and Chinook salmon from Lake Michigan have shown a decline in those PCB levels over the last years?

A Not over the last years, because I have not reviewed the most recent information, if you are referring to the most recent analysis.

Q Over the last five years.

A ~~Yes. There is data showing some decline in those species.~~

Q Is it your best opinion that in fact PCB levels in fish found in Lake Michigan will continue to decline in the future?

A I think that is a debatable point, requiring assumptions pertaining to the current equilibrium and input rates, and would require some time to develop the best -- to agree wholly with that question.

Q Well, have you made or attempted to make any projections about the future directions of PCB levels in fish found in Lake Michigan?

A In terms of formal publications, I have not. I have discussed and reviewed the information that

Ther L. Urban  
Confidential Statement  
1000 East La Salle Street  
Chicago, Illinois 60601

## Stalling - direct (Featherstone)

is available in regard to equilibrium between sediments and the ultimate availability or equilibrium, based on the first order or second order of delay of PCBs.

Q What have you concluded?

A It is my opinion that the rate of decline will slow. At what point in time, I am absolutely -- I am not certain. But in the five year frame of reference, I think we will see, in my opinion we will see a two stage delay curve, in which equilibrium of sediments containing PCBs with the water column is likely to begin to occur, and that the rate of decline will slow.

Q If I understand your answer, it is your best opinion that PCB levels in fish found in Lake Michigan will continue to decline in the future?

A Only insofar as we don't have a catastrophic event in one of the harbors, where there is a large loading of PCBs, such as might be found in Waukegan or is found in Waukegan. If we have a catastrophic weather event that causes a major dislocation of PCB sediments, it is entirely possible that the rate might not decrease.

Q Catastrophic events aside, would you agree

Theo L Urban  
Certified Specialist and Registrar  
130 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

that it is your best opinion that PCB levels in fish found in Lake Michigan will continue to decline in the future?

A I would have to say yes.

Q Have you made any effort whatsoever to determine whether or not a catastrophic event could occur in Waukegan Harbor?

A A storm can occur at any event. We have no control over that.

Q Well, you presume. Have you made any effort to calculate that or determine whether that is possible?

A Well, given the fact it is possible we could have a tornado in the middle of Chicago.

Q Have you tried to determine whether or not a tornado up in Waukegan Harbor would result in any increase in the flow of PCBs out of Waukegan Harbor?

A Any disturbance in the Harbor would probably result in increased in put.

Q Have you made any effort to determine that?

A It is simply a matter of transport.

Q Have you made any effort to determine that, Doctor?

A No, I have not.

Ther L Urban  
Certified Shorthand Reporter  
100 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

Q Have you ever seen Waukegan Harbor?

A I have been on the Lake and been by it, but I have never been in the site.

Q Is it important to have an understanding of the topography of Waukegan Harbor in order to determine whether a particular storm event would increase the flow of PCBs there out of the Harbor?

A Probably not.

Q Probably not?

A Probably not.

Q That is a guess on your part?

A I indicated earlier in an answer that any disturbance of major consequence would increase transport if it involved storm events and increased river flow.

Q Do you consider, Dr. Stalling, the recent decline in PCB levels in fish found in Lake Michigan to be significant? I am talking about decline over the last five or six years.

A By "significant," that is statistically?

Q Significant to you as an analytical chemist who follows this data. Is it a significant change?

A Yes, it is a statistically significant

Thos L. Urban  
Certified Sheriff and Registrar  
174 S. La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

decrease, that is, it is a real decrease, I guess.

Q Is the decline in the PCB levels in fish found in Lake Michigan attributable in your judgment in part to the burial of those PCBs in the sediments of the Lake?

A In my opinion, no, not entirely, not solely.

Q I didn't say solely. I said in part.

A In part, yes.

Q In part, yes?

A In part, yes.

Q Is the burial of PCBs in sediments of Lake Michigan an important reason for the decline in the PCB levels in fish found in Lake Michigan, in your judgment?

A It is a factor. An equally important factor would be the cessation of direct input.

Q Does the burial of PCBs contribute to a reduction in the PCB levels because the PCBs are no longer available to be picked up by the fish?

A Only partially. PCBs that are buried, covered over with recent sediments from work done on dredging stimulation, they still ultimately migrate through those sediments. Essentially diminishes the

Ther L Urban  
Chief of Staff and Recorder  
U.S. District Court  
Detroit, Michigan



Stalling - direct (Featherstone)

rate of transport. The transport appears to occur based on information in the literature.

MR. FEATHERSTONE: Would you read the answer back, please.

(Record read.)

BY MR. FEATHERSTONE:

Q Would you agree that the burial of the PCBs reduces the amount of PCBs available to be picked up by the fish, and that in part explains why the PCB levels have declined recently?

A One of two -- Only one of two possibilities, that the transport -- that the burial sediment decreases the rate of available -- or decreases the availability. But equally important would be the stop of, you know, the cessation of direct input.

Q Well, I move to strike the last part of your answer, Doctor. I only asked you about burial. I understand what you had to say about direct input.

A Okay.

Q Please respond to my questions.

A Would you restate your question.

Q Dr. Stalling, is it true that your laboratory had found nationwide that PCB 1242 is disappearing from the environment?

Theo L. Urban  
Certified Shorthand Reporter  
170 South La Salle Street

## Stalling - direct (Featherstone)

A In terms -- Yes.

Q Is it the judgment of you and your laboratory that this is happening because PCB 1242 is degrading?

A Some components are degrading.

Q Do you have any time trend data that shows whether or not non-ortho PCBs are decreasing in environmental samples?

A No, I do not.

MR. FEATHERSTONE: May I have the question back, please.

(Record read.)

BY MR. FEATHERSTONE:

Q Do you have an opinion whether or not non-ortho PCBs are decreasing in the environmental samples?

A If I have no data, it's difficult to have an opinion specifically on non-ortho PCBs.

Q So I take it that is a way of saying no to my question?

A No.

Q Is all of your work and all of your measurements done on whole fish?

A Not all, but largely.

Q In any event, the work that you did concerning

Thom L. Urban  
California State Board of Fisheries  
1000 California Street  
Sacramento, California

**Stalling - direct (Featherstone)**

**Waukegan Harbor is data reported on a whole fish basis?**

A That is the description of the samples we received.

Q That is what the United States Government asked you to do, do it on a whole fish basis?

A We were asked to analyze samples submitted.

Q Was there any discussion with the United States Government as to whether or not the samples submitted should be edible portions of fish rather than whole fish?

A No, sir.

Q Are you familiar with the data that shows PCB levels in edible portions of fish?

A Yes.

Q In your judgment does that data show that PCB levels measured on a whole fish basis are higher than PCB levels when measured on edible portion basis?

A        In response to whole fish and fillet, PCB concentration, the concentration is more a direct consequence of the fat content of the whole organism versus the tissue. When expressed on a fat content basis, the difference between whole fish and fillet is not probably -- or not significant.

Theo L Urban  
Certified Standards Reporter  
for the City of St. Louis  
10000 W. Florissant Ave.  
St. Louis, MO 63123  
314-763-1414

Stalling - direct (Featherstone)

Q Doctor, I didn't ask you about normalized in the data sense. All I want is a simple answer to this question.

In your review of the data are the PCB levels found on a whole fish basis higher than those found reported on the edible portion basis?

A Yes, they are.

Q Have you made any effort to determine for any particular species how much lower PCB levels are when reported on an edible fish basis as opposed to a whole fish basis?

A I would have to answer yes, and go back to the previous comment that those differences are explained by fat content, in the main. The major portion of that difference is due to the fat content.

Q In other words, the reason the edible portion of the fish has lower concentration of PCBs is it has a lower fat level than other parts of the fish?

A That is correct. The primary reason.

Q Now, have you made any effort to determine what percentage of the concentration of PCBs when measured on a whole fish basis is contained in the edible portion of that fish?

Thom L Urban  
Chief Fish Scientist, Department  
of Fish and Game, State of Oregon

## Stalling - direct (Featherstone)

A This is a difficult question to answer directly. I can only respond by stating that PCB concentrations in fillets are 30 to 50 percent of those in the whole body, based on recollections of data from laboratory studies and data from the Food and Drug Administration analyses.

Q Do non-ortho PCBs tend to concentrate at higher levels in the fat of a fish than they do in the edible portion of fish?

A I am not certain I can answer the question directly. I think that they are essentially distributed in all parts of the body. They tend -- There is literature that answers your question. In work published recently it shows that partition coefficients controls whether the isomers are in the fat or in the tissue. Based on my recollection of that literature, the concentration of non-ortho chlorine might be expected to be higher in the edible portion than in the fat, based on these involved partition coefficients.

Q Is it your recollection that the literature shows that non-ortho PCBs divide between edible and fat portions of the fish differently than other

Ther L Urban  
Certified Shorthand Reporter  
175 South 10th Street  
Chicago, Illinois 60605

## Stalling - direct (Featherstone)

PCBs?

A Yes. There is data showing distribution in human milk and plasma and whole total bodies in which the fat content of the non-ortho substitution is lower, and these range from a factor of one to three. The range of differences are within a factor of three. And that these non-ortho substituted PCBs are on highest concentrations in mother's milk, and this reference is from Dr. Wolfe at Mt. Sinai.

Q In your data reported in Exhibits 1 and 2, the non-ortho PCB data is reported on a whole fish basis?

A That is correct.

Q Can you make any projections, with any reasonable degree of scientific certainty, about what those non-ortho PCB levels would be in the edible portion of the fish?

A Based on Mary Wolfe's publication on distribution of PCBs, non-ortho and one-ortho chloro PCBs, and Steven Safe's review of the literature, one would conclude from their data that non-ortho and one ortho chloro PCBs would be higher in tissue than in fat, and/or proportional whole body residue.

Theo L. Urban  
Certified Strength and Posture  
134 South La Salle Street  
Chicago, Illinois 60607

## Stalling - direct (Featherstone)

Q Look at Exhibit 1 to your deposition, please. Take a look at Table 1. At the bottom of Table 1 you have concentration measurements for 3,4,3,4 PCBs, is that correct?

A Yes.

Q And it says 2300 parts per trillion.

A That is correct.

Q That is reported on whole fish?

A That is correct.

Q Can you tell me what that figure would be if it were reported on an edible fish basis?

A Using the information from Steven Safe's literature review, it might be on a proportional basis factor of two to three higher. But again I -- working strictly on a projection from differences in partition coefficients.

Q Well, are you prepared to state at trial under oath and as a matter of science that the level of non-ortho PCBs in the edible portion of this carp, assuming it is edible, would be in the neighborhood of two to three times higher than 2300 parts per trillion?

A Based on the qualifications I just stated,

Theo L. Urban  
Certified Steno and Reporter  
10 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

and on published literature that exists pertaining to the distribution of these non-ortho and one ortho chloro with 3,4,3,4 substitution, you would certainly conclude those data are higher.

Q Mary Wolfe's research that you have referred to, did that involve studying the distribution of non-ortho PCBs in fish?

A No.

Q Steve Safe's research that you referred to, did that involve the study of the distribution of non-ortho PCBs in fish?

A In one of his publications he includes fish, and he is currently, and I believe the record, the literature would show he has included fish samples in some of the work reported.

Q Do you happen to know or remember the particular work of Mr. Safe that you are referring to?

A I do not.

Q Has your laboratory made any effort to duplicate Mr. Safe's work to find out if it is correct?

A We did work -- we may have a direct answer. I may have a direct answer to your question, but I would have to consult publication in the New York

Thea L. Urban  
Certified shorthand Reporter  
104 South La Salle Street



## Stalling - direct (Featherstone)

Annals of Science pertaining to the distribution of 3,4,3,4 in the tissue. We have done research on that in terms of accumulation of 3,4,3,4, but I have not, in terms of duplication of Steve Safe's work, we have not duplicated in detail his work.

Q Do you know what fish species Dr. Safe used in this study?

A I think it was trout, it is my recollection.

Q Based on your work and research into PCBs in fish, do different species of fish concentrate different PCBs in different ways, to different degrees?

A On the basis of your question I would say no, based on the work done to date. I could not say it is not possible, but no, as far as -- I answered an earlier question pertaining to the species not being a major factor again. If you look at percent lipids, that is a big part of answering your question.

Q Do you have any expertise in toxicology?

A On a qualification I would say yes, and explain the qualification, if I may, or if you would like.

Q You say on a qualification you would say yes?

MR. WHITE: Go ahead and answer the question.

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
CHICAGO, ILL. 60603

## Stalling - direct (Featherstone)

BY THE WITNESS:

A I work as one section chief in a Laboratory that is a multi-disciplinary laboratory. It involves experts in toxicology, physiology, pharmacokinetics, enzyme induction, microbiology. As part of my responsibility it is necessary for me to know their literature, to be able to converse with them on a scientific valid basis, and to assist in formulation of designs involving toxicology and these other disciplines. And over the last 14 and a half years I have acquired a detailed understanding of pharmacokinetics, some structure activity relationship, and we have established jointly, as joint studies with Dr. Foster Mayer, a well-respected aquatic toxicologist, and as part of the objectives of the chemistry research program it is necessary and was necessary to define analytical protocols and approaches which would provide the data supporting and integrated with toxicology studies.

Q Are you a fisheries biologist?

A No, I am not.

Q Are you an expert in the movement of PCBs?

A From a viewpoint of having read the literature

Thea L. Urban  
Certified shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

fish movement in or near Waukegan Harbor?

A No, I have not.

Q Do you have any information on that?

A In relationship to -- Yes. Okay.

Q Do you have specific information regarding movement in or near Waukegan Harbor?

A Only in the Great Lakes, in the Lake Michigan proper.

Q But nothing specific to Waukegan Harbor?

A No, I do not.

Q Do you know the species of fish that are most frequently caught by sport fisherman in the Illinois waters of Lake Michigan?

A I have read that information on creel census.

Q What are those species?

A My guess is, now again this is from recollection, that your salmonoid is one group, and the pan fish, depending on -- and perch, and the like, pan fish. Again, it's been a long time.

Q Salmonoid would be lake trout and salmon?

A Coho salmon and lake trout.

Q The pan fish include yellow perch?

A Yellow perch, bullhead, white.

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

Q Do you know which species is the most important species for sport fisherman in the Illinois waters of Lake Michigan?

A Yes.

Q Which species is that?

A Let me clarify the comment. In terms of economic value, the Coho salmon and lake trout were the largest dollar-based industry, in terms of the expenditure for average fisherman. Beyond that in terms of numbers caught per expedition, I simply have to refer to the literature. I can't recall.

Q Is the knowledge of fish movement in or near Waukegan Harbor important for determining potential exposure to fish from the PCBs in Waukegan Harbor?

A I suppose so, yes.

Q Do you have any knowledge of the fish population in Waukegan Harbor?

A No, I don't have.

Q Do you have any knowledge of fishing activities in or near Waukegan Harbor?

A I have not read -- No.

Q Have you spoken with any fisheries biologist to check if any opinions you might have about the

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Ill. 60603

Stalling - direct (Featherstone)

availability of the PCBs in Waukegan Harbor to fish?

A No, I have not. I would like to comment beyond that no answer. It is that there is no unique factors that I am aware of that would change the availability of PCBs there versus any other place in the Lake.

Q I suppose the critical part of that answer is none that you are aware of, is that right?

A True.

Q Is that right?

A Yes.

Q Have you personally done research in the bioconcentration of PCBs?

A Yes, I have.

Q What fish species have you studied in that regard?

A We have studied the four representative species used in our laboratory.

Q Which are?

A Channel catfish, or a catfish, a representative salmonoid such as a Coho, brook trout or lake trout, in some cases. Fathead minnows, and bluegills.

Q Has your laboratory calculated bioconcentration

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

rate of PCBs to be representative of many of the fish in Waukegan Harbor?

A Probably not.

Q Is the bluegill considered a resident fish?

A It is. But --

Q Do you know whether or not most of the fish in Waukegan Harbor are resident fish or migratory fish?

A I can't answer that question.

Q I take it because you don't know the fish population in Waukegan Harbor or fish movement in or near Waukegan Harbor, you cannot give me a representative bioconcentration factor for fish in Waukegan Harbor?

A I can give you a -- Yes.

Q What figure would you give me?

A In the range of 50,000 plus.

Q 50,000 to what?

A 30 to 50. Whatever is in the water column -- Based on laboratory studies, what is in the water column concentration would effectively be magnified to the minimum of 30 to 50,000 times under laboratory conditions. It is my estimate that the bioconcentration

Thea L. Urban  
Certified shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

factor in the environment exceeds 100 to 200,000.

Q Well, are you prepared to testify that as a matter of science that bioconcentration factor of 100 to 200,000 would apply to those fish in Waukegan Harbor?

A No reason they shouldn't.

Q Do you consider that to be a representative bioconcentration factor?

A For PCBs, yes. Based on real world data.

Q Have you seen any bioconcentration studies done in Waukegan Harbor?

A I haven't observed them.

Q Have you read any reports about them?

A No, I have not.

Q Has anybody discussed with you any of the bioconcentration studies done in Waukegan Harbor?

A No.

Q In the bioconcentration tests that your laboratory runs for PCBs, are those tests generally 28 to 30 days in duration?

A Generally they are longer than 28 days. But a 20 to 30-day test for bioaccumulation would be minimum.

Theo L Urban  
Certified shorthand Reporter  
134 South La Salle Street  
Chicago, Ill.

## Stalling - direct (Featherstone)

Q In your last answer you said 20 to 30 days. Did you intend to mean 28 to 30 days?

A No. I am saying two to three weeks is the minimum figure to even begin to estimate bioaccumulation. You would get low values.

Q I want you to assume that a bioconcentration test for PCBs was done for 28 days in Waukegan Harbor, and at the end of that period of time bioconcentration factors were measured. Okay?

A All right.

Q Can you tell me how close the bioconcentration figure measured after 28 or 30 days would be to what you would consider to be representative bioconcentration?

A Half order of estimate. Fifty percent, probably. You are asking for an opinion. I am giving you an opinion.

Q Have you done any studies personally to determine that?

A In terms of Waukegan Harbor I have done no research.

Q Is it fair to say that the standard laboratory bioconcentration test runs for 28 to 30 days?

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street



Stalling - direct (Featherstone)

and let him finish his answers. If you don't like an answer --

MR. FEATHERSTONE: Only if you cooperate.

MR. WHITE: If you don't like an answer, Bruce, there is no reason to cut him off and change the question on him.

MR. FEATHERSTONE: I realize, Mr. White, that as a result of yesterday's hearing the Government has told Dr. Stalling to get his licks in whenever he can.

MR. WHITE: That is your characterization.

MR. FEATHERSTONE: But you may ask whatever questions you want to, Mr. White, on cross examination.

MR. WHITE: All I am asking is that you continue to ask your questions.

BY MR. FEATHERSTONE:

Q Dr. Stalling, your study into the bioconcentration of the 3,4,3,4 PCB, did you calculate a bioconcentration factor for that isomer of PCB?

A I think the answer is yes, and I don't recall the exact values. It is in the literature.

Q Do you recall the approximate value?

A By "approximate," I am going to say 10,000,

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

were eliminated more rapidly, what you are in fact saying is they did not bioconcentrate as rapidly or as to as great an extent as other PCBs?

A To as great an extent is the answer I would say to your question. They are more physiologically distributed in the organism, and are not as lipid-soluble. And going back to the comment I made earlier about Safe's work, they fall in the expected behavior based on partition coefficient.

Q What other non-ortho PCBs did you study other than 3,4,3,4 PCBs?

A The analytical characterization has included measurements for 3,4,3,4,5; 3,4,3,4 -- 3,4,5,3,4,5. In general the hexachloro compound is of minimal concentration.

Q When you say hexachloral compound you are referring to 3,4,5,3,4,5?

A That is correct.

Q Did you just say that the bioconcentration of that isomer or that PCB 3,4,5,3,4,5 is minimal?

A No, I did not say that. I am saying we -- I should have said we have done no work on the hexachloro compound in the bioaccumulation.

Theo L. Urban  
Certified Sheriff and Reporter  
134 South L. Salle Street

Stalling - direct (Featherstone)

Q Have you done work on the 3,4,3,4,5 PCB for bioconcentration?

A I think that was included in the work on the -- Yes, to the best of my recollection, from New York Academy of Science publication.

Q Was this in the same publication in which you reported on the work in the bioconcentration factors for 3,4,3,4 PCB?

A That would have been a part of that study. My memory is incomplete at this moment. I simply cannot remember.

Q What bioconcentration factor did your laboratory calculate for the PCB 3,4,3,4,5?

A I don't recall that data. I just said that a moment ago.

Q Can you give me an approximate value?

A I don't, no, no, I cannot remember the details of that. You have to see the publication.

Q The publications you referred to in connection with your testimony about bioconcentration factors for 3,4,3,4 PCB, and for the 5 chlorene non-ortho PCB that you have rferred to, what years were those publications?

Stalling - direct (Featherstone)

A I think that is a 1979 publication.

Q Did you have co-authors?

A Yes. Jim Huckins, Herm Sanders, and I  
can't recall if there was --

Q Dr. Johnson and Mr. Petty?

A I don't recall. I'd have to look at it.

Q I hand you a document. Is the publication  
the first one that is listed on that document?

A Yes.

Q Would you identify that on the transcript.

A New York Academy of Science, Volume 320,  
48 to 59, 1979.

Q Have you done any biodegradation work on  
the PCB 3,4,3,4,5?

A No, I have not.

Q Have you done any biodegradation work at all  
on PCBs?

A We did do some analytical work, yes.

Q Which PCBs?

A These were hydroxy PCB derivatives.

I would like to comment. I have done no  
metabolism studies on these isomers per se.

Q Do you have any data that shows whether or

Theo L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

not the PCB 3,4,3,4 biodegrades in the environment?

A I do not.

Q Do you have any data that shows whether or not the PCB 3,4,3,4,5 biodegrades in the environment?

Your answer is no?

A No, I do not.

Q Does the term preferential bioaccumulation have any meaning to you?

A Yes.

Q What does it mean?

A I would say that an organism, an exposure to a group of chemicals results in a preferred or a bioaccumulation beyond that described by log partition coefficients, or could be directly related to log partition coefficient as one.

Q Does that mean that when one says a particular PCB bioconcentrates preferentially to others, that it bioconcentrates at a higher rate, or to a greater degree than others?

A When normalized -- yes. But when normalized to the partition coefficient from that basis. Because that is the only rational way to treat the information, I guess.

Theo L. Urban  
Certified Shorthand Reporter  
1700 S. 1st St., S.W.

Stalling - direct (Featherstone)

Restate that question. I am not sure I am tracking with what your intent is.

MR. WHITE: If you don't understand the question --

BY THE WITNESS:

A Yes, I don't understand the question. Restate that, I don't understand it.

BY MR. FEATHERSTONE:

Q Is it fair to say that the PCBs with the higher bioconcentration factors are the PCBs that preferentially bioaccumulate?

A Yes.

Q Have you done any studies into the bioconcentration of dibenzofurans?

A Yes.

Q Has that been reported in the literature?

A No, it has not.

Q Is that study final?

A No.

Q Is that study still ongoing?

A It is in the process. Planning and -- Okay. it is in the process.

Q In other words, the data has not been

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

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generated at this point?

A We have -- No. Let me -- No. Okay.

Q No, I am wrong, or yes, I am correct, the data has not been --

A Some data is available, or has been generated. Preliminary data is available or has been generated. Final study is not complete.

Q Accordingly the conclusions of that study are not complete?

A Of that study, that is correct.

Let me clarify that. The laboratory studies versus analytical measurements dealing with bioaccumulation. The study I had reference to is a laboratory-based study versus an analytical characterization study of environmental residues of dibenzofurans.

Q The laboratory study that is ongoing, is that also your first study of the bioaccumulation or bioconcentration of dibenzofurans?

A First laboratory study.

Q Do the terms bioaccumulate and bioconcentration mean the same thing to you?

A They are largely synonymous. The answer

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603  
(312) 467-1112

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is no, but they are largely synonymous.

Q Do you have any opinion, with any reasonable degree of scientific certainty, of the quantity of dibenzofurans in the settlement of Waukegan Harbor?

A No, I do not.

Q Do you have any opinion, with any reasonable degree of scientific certainty, about the quantity of non-ortho PCBs in the sediments of Waukegan Harbor?

A Yes.

Q What is the quantity of non-ortho PCBs in the sediments of Waukegan Harbor?

A The characterization of their quantitation is included in the item 2, or in Exhibit 2. We have analyzed samples, and the data from those analyses are present.

Q Well, in fact what is in Exhibit 2 are your analyses for non-ortho PCBs in five sediment samples from Waukegan Harbor.

A That is correct.

Q My question to you is can you make a projection from that data to an estimate of the total quantity of non-ortho PCBs in the sediments of Waukegan Harbor?

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Certified Shorthand Reporter  
134 South La Salle Street



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A With the information I have, no.

Q In Exhibit 2, you report findings concerning the presence of non-ortho PCBs in seven fish samples, correct?

A I think that's -- there are more than seven samples, including the National Pesticide Monitoring Program data.

Q You are absolutely correct, Dr. Stalling. It is a poor question, I am sorry.

In Exhibit 2 you report the levels of non-ortho PCBs in seven fish samples from Waukegan Harbor?

A That is correct.

Q On the basis of those seven samples, are you able to make any projection, with any reasonable degree of scientific certainty, as to the quantity of non-ortho PCBs in fish found in Waukegan Harbor?

A The same answer to the previous question. No, not with the information available.

Q Based on any of the information that is found in Exhibit 2, are you able to make any protection, with any reasonable degree of scientific certainty, about the quantity of non-ortho PCBs in the fish in Waukegan Harbor?

Ther L Urban  
Certified Shorthand Reporter  
100 South La Salle Street  
Chicago, Illinois 60603

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A If the samples are representative, yes.

Q Do you know that?

A Well, you assume they are. I will make --  
No. I don't know that. Okay.

Q Well, assume that seven fish samples reported in Exhibit 2 are representative of the fish in Waukegan Harbor. Can you tell me, with a reasonable degree of scientific certainty, the quantity of non-ortho PCBs in fish, full quantity, in Waukegan Harbor?

A Yes. Provided you can supply me with what the biomass is.

Q What do you mean by biomass?

A How many fish, how many pounds of fish.

Q Do you need that in order to be able to answer that question?

A That is correct.

Q Is there any way you can analyze for non-ortho PCBs in the water column?

A Yes.

Q Was there ever any discussion about doing that for samples from Waukegan Harbor?

A No.

Q Did you recommend that at all?

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Certified Shorthand Reporter  
134 South La Salle Street

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A Didn't discuss it.

Q Do you have any data anyplace relating to the concentration of non-ortho PCBs in the water column of Lake Michigan?

A No.

Q Is it fair to say then that you are unable to make any projection, with any degree of scientific certainty, about the quantity of non-ortho PCBs in the water column of Waukegan Harbor?

A No, it is not fair -- restate your question. The answer is in the negative, I can't -- or I can make some projections, yes.

Q Even though you have no water column data?

A You know what total PCB concentration is.

Q In the water of Waukegan Harbor, do you know that?

A No, I don't know that. You said Lake Michigan, if I understand your question right.

Q Well, if you knew the total concentration of PCB in the water column of Waukegan Harbor, could you, with a reasonable degree of scientific certainty, make a projection about the quantity of non-ortho PCBs in that water column?

Ther L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Ill.

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A I think you might estimate it.

Q How would you do that?

A A simple fractional composition of the residues as delineated in Aroclors, based on the composition of the Aroclors present, or the total PCB content. A simple mathematical calculation.

Q Let me see if I understand that simple mathematical computation. Are you saying that you would take the concentration of non-ortho PCBs in Aroclor 1242 for instance, and apply that concentration to the total mass of Aroclor 1242 in the water column of Waukegan Harbor?

A That is one approach.

Q Do you consider that a valid approach?

A If you state -- Yes, if you state the composition of PCBs in the water column is Aroclor 1242, why wouldn't you do it.

Q Have you yourself ever written anywhere that using such an approach, there is tremendous uncertainty in doing that --

A I have not.

Q -- because of the differences -- Let me finish. -- because of the differences between newly

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

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manufactured Aroclor and that which has somehow found its way into the environment?

A You have three questions in one. Break that down.

Q You can't answer the question?

MR. WHITE: Would you reread the question.

BY THE WITNESS:

A I want to restate -- restate the question.

(Record read.)

MR. WHITE: Answer the question.

(Sotto voce discussion had between

Mr. White and the witness.)

MR. WHITE: Let him restate it.

BY THE WITNESS:

A I'd ask you to reclarify your question.

BY MR. FEATHERSTONE:

Q Dr. Stalling, I apologize if I asked this question before, but looking at my notes I can't just remember if I did. Is PCB 3,4,3,4 degradable?

A I can't answer the question personally, but the literature suggests that it is metabolized.

Q Do you know of any evidence that suggests that PCB 3,4,3,4 is not biodegradable?

Theo L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

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A No, I don't.

Q Would you take a look at Exhibit 1 to your deposition.

A Okay.

Q Doctor, on pages 2 and 3 of that document your laboratory reports certain dioxins found in those two fish, is that correct?

A In one sample?

Yes.

Q Do you have any opinion, with a reasonable degree of scientific certainty, the origin of those dioxin in those two fish samples?

A In view of the preceding discussions, the origins of the dioxins probably don't -- Well, I guess yes, I have an opinion.

Q What is the origin of the dioxins in that report in those two fish samples?

A As for an opinion, I'd say they are related to pentachlorophenols in the system, or from the combustion or organochlorophenols -- chlorophenols. Other than 2,3 -- other than the 2,4,5 trichlorophenols.

Q Your first one was pentachlorophenol?

A Pentachlorophenols, p-e-n-t-a-c-h-l-o-r-o-p-h-e-n-o-l.

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Q Your second was organochlorophenol?

A Just call it chlorophenol other than 2,4,5 trichlorophenol.

Q You are saying phenol?

A Phenols, s, plural, chlorophenols.

Q It is spelled p-h-e-n-o-l-s?

A That is correct.

Q Is it fair to say that you do not have an opinion that those dioxins came from the use of PCBs?

A If you are -- Restate your question. I think you have a double negative. But go ahead.

Q If I do, I apologize. Is it fair to say that in your judgment those dioxins in those two fish samples did not come from use of PCBs?

A That is correct.

Q Doctor, referring again to Exhibit 1, your laboratory detected levels of dibenzofurans in the two fish samples, is that correct?

A That is correct.

Q Have you ruled out as a matter of science that some of those dibenzofurans may have come from a source other than the use of PCBs?

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street

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A No. But I have no other alternative than that conclusion.

Q Well, are dibenzofurans found in chlorophenols?

A In some material. Not all.

Q Are chlorophenols found in Lake Michigan?

A I have no data on that. However, it is fair to say that furans are found in PCBs.

MR. FEATHERSTONE: I move to strike that last sentence as non-responsive to the question.

BY MR. FEATHERSTONE:

Q When your laboratory ran the analyses that are shown in Exhibit 1 for dibenzofurans in the two fish samples, did you or anyone in your laboratory make any effort to calculate any expected value of dibenzofuran in those samples?

A No.

Q Do you know what I mean by expected value of dibenzofurans?

A I will let you clarify what you mean by "expected value."

Q What I mean is did anyone take a look at the PCB levels reported in those fish and make any



## Stalling - direct (Featherstone)

effort to project what you would expect to find in the way of dibenzofurans?

A No. PCBs were not measured in these particular samples.

Q Did anyone make any effort to calculate the expected quantity of dibenzofurans in those two fish based on the non-ortho PCBs found in those two fish samples in Exhibit 1?

A No.

Q Can you do that?

A No. I think your question has a -- makes reference to dioxin. And if you please read -- reread the question.

(Record read.)

BY THE WITNESS:

A My error. No.

BY MR. FEATHERSTONE:

Q Are you able to do that?

A Not with this data.

Q Are you able to do it with other data that you are aware of?

A We have not done so.

Q The question is are you able to do it?

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Certified Shorthand Reporter  
174 South La Salle Street

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A We could, yes.

Q How would you do it?

A Take the description of the dibenzofurans --  
I mean the concentration of the total PCBs in relationship to composition of Aroclors making up the residue, and then calculate that known fraction of non-ortho substituted PCBs which would be on the total order of about 30 percent over all of the PCBs, for total non-ortho substitute PCBs. That information is presented in Exhibit 2.

Q Have you done any research into the concentration of dibenzofurans in PCB 1242?

A No, I have not.

Q Have you done any research into the concentration of dibenzofurans in Aroclor 1248, PCB 1248?

A No.

Q Do you know whether PCB 1242 or PCB 1248 are reported to be in the sediments of Waukegan Harbor?

A They are.

Q They are?

A They are, yes.

Q Do you know whether there are any other PCBs or Aroclors in those sediments?

Ther L. Urban  
Certified Shorthand Reporter  
110 South La Salle Street  
Chicago, Illinois 60603

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A In the main -- No.

Q In the main it's PCB 1242 and 1248?

A That is correct.

Q Do you know in what approximate ratio?

A Based on -- Yes.

Q And this is for sediments in Waukegan Harbor, correct?

A That is correct. You asked the question about sediments.

Q What ratio?

A On the order of one to one to two to one for 42 to 48.

Q Did you say one to one or two to one?

A That is right, in that range.

Q The dibenzofuran levels shown for the two fish tested and reported in Exhibit 1, do those dibenzofuran levels correlate with the levels reported for non-ortho PCBs?

A No. I think there is no direct relationship.

Q Doctor, I can't even hear you at this stage.

A I am sorry. I am getting a little tired.

No. I think there is no direct relationship between non-ortho PCBs and dibenzofurans.

Ther L Urban  
Certified Shorthand Reporter  
104 South La Salle Street  
Chicago, Illinois 60603

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Q Would you expect the fish sample that has the higher level of non-ortho PCBs to have a higher level of dibenzofurans, other things remaining equal?

A I would have to -- I can't answer the question based on the information I have, because I don't know the composition of the PCB residues between these two fish. You may want --

Q Well, you know from Exhibit 1 the concentration of non-ortho PCBs in those fish, at least as measured by your lab.

A Right.

Q My question to you is would you expect the dibenzofuran level to be higher in the fish that has the greater concentration of non-ortho PCBs, that information which you have in front of you, all other things being the same?

A No, because there is no direct relation, as I indicated earlier in the previous question, between orthochloro PCBs and the potential formation of dibenzofurans from ortho-substituted PCBs, which are the known precursors in the literature.

MR. FEATHERSTONE: Let's break for lunch.

(The deposition was recess to 1:45 this date, September 9, 1982.)

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60604

IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF ILLINOIS  
EASTERN DIVISION

THE UNITED STATES OF AMERICA,	)	
	)	
Plaintiff,	)	
	)	
vs.	)	No. 78 C 1004
	)	
OUTBOARD MARINE CORPORATION	)	
and MONSANTO COMPANY,	)	
	)	
Defendants.	)	

The deposition of DR. DAVID STALLING, resumed  
pursuant to recess, on September 9, 1982, at 219 South  
Dearborn Street, Chicago, Illinois, on September 9,  
1982, at the hour of 1:45 p.m.

PRESENT:

MR. JERROLD H. FRUMM

MR. JAMES WHITE

MR. MICHAEL A. POPE

MR. RICHARD J. KISSEL

MR. JEFFREY C. FORT

MR. BRUCE FEATHERSTONE.

ALSO PRESENT:

MR. HUGH THOMAS.

MR. MARK SCHNEIDER

MR. JOHN VAN VRANKEN

MR. FRED D. HILEMAN

MR. RICHARD YOUNG.

Thea L. Urban  
Certified Shorthand Reporter  
175 South La Salle Street

DR. DAVID STALLING,  
called as a witness by the Defendant Monsanto, having  
been previously duly sworn, was examined and testified  
further as follows:

DIRECT EXAMINATION (Resumed)

BY MR. FEATHERSTONE:

Q Dr. Stalling, are chlorophenols a source  
of dibenzofurans?

A In the literature it's been established  
that both dioxins and dibenzofurans can be formed  
during the manufacture of chlorophenols and/or their  
combustion, yes.

Q Are you aware that there are reports in  
the literature that have linked the environmental  
levels of chlorophenols with the presence of dibenzo-  
furans?

A Yes. But primarily in combustion.

Q Are you familiar with what is known as  
fly ash?

A Yes, I am.

Q Is fly ash a source of environmental  
dibenzofurans?

A You say is it?

Q Yes.

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Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

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A Yes, and dioxins as well.

Q Have you seen reports or data in the literature that chlorophenols are found in the Great Lakes other than Lake Michigan?

A I have not read the literature. No, I am not familiar with it.

Q Do you have an opinion about whether chlorophenols have found their way into Lake Michigan?

A My assumption -- Yes, probably.

Q I am sorry. Did you say yes, probably?

A Yes.

Q Do you have an opinion whether fly ash has found its way into Lake Michigan?

A I'd have to say no. I don't have an opinion on that matter. I am not familiar with that literature.

Q If chlorophenols are found in Lake Michigan, could dibenzofurans that have been found in fish have come from those chlorophenols?

A Only under very remote circumstances, I think. Yes, it could come from.

Q Are you aware of any scientist who has attempted to determine to what extent chlorophenol contamination of a lake has contributed to the

Theo L Urban  
Certified shorthand Reporter  
139 South La Salle Street  
Chicago, Illinois 60603

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dibenzofuran contamination of the water body?

MR. WHITE: Excuse me. A lake or the Lake Michigan?

MR. FEATHERSTONE: I think I said a lake.

MR. WHITE: A lake.

BY THE WITNESS:

A Yes, I think there have been studies, in the affirmative for your question. But not that dibenzofurans were the consequence, but dioxins. Insofar as my recollection goes, the literature is primarily tied with dioxins as a consequence of a chlorophenol inputs.

BY MR. FEATHERSTONE:

Q Well, you are co-author of at least a draft of an article, aren't you, that states dibenzofurans in environmental samples may well have come from chlorophenols?

A I think that paper cites that direct correlation with PCBs for dibenzofuran levels and in only areas where chlorophenol production, principally 2,4,5 trichlorophenol occurred, measurable quantities of TCDD were found.

The interpretation I have from the literature

Thea L Urban  
Certified Shorthand Reporter  
134 South La Salle Street



Stalling - direct (Featherstone)

research we have done is that dioxins are the more direct consequence of chlorophenol use than are dibenzofurans, and only in the case of combustion wherein PCBs may have been involved with the combustion are significant dibenzofuran quantities produced.

MR. POPE: Can I ask that the reporter read the answer back, please.

(Record read.)

BY MR. FEATHERSTONE:

Q Would you look at Exhibit 1 to your deposition, please. In Table 1 you claim that the four chlorene dibenzofuran is the 2,3,7,8 isomer, is that correct?

A That is correct.

Q In Table 2 you do the same thing.

A That is correct.

Q At the end of the paper you have a footnote.

A That is correct.

Q Which says that identification in both tables is tentative, is that correct?

A That is correct.

Q Now, first of all, that footnote says that

Theo L. Urban  
Certified Shorthand Reporter  
130 S. W. 11th St., Miami, Fla.

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all 37 four chlorene isomers are not available.

A That is correct.

Q Are there 37 or 38 four chlorene isomers?

A If you count -- I would have to recall the literature. My assumption is there are 37 furan isomers other than the 2,3,7,8. But I am not certain at this instant from recall. We have 2,3,7,8, but we do not have all 37 other isomers.

Q How many of the 38 four chlorene isomers do you have?

A In our laboratory we probably have about ten or fifteen. I don't recall exactly. But I might add that we have cooperated on these analysis with Dr. Rudy Buser and Dr. Rappe in Sweden, and have relied on their published techniques for identification. The corroborative determinations.

MR. FEATHERSTONE: Would you read the first part of his answer.

(Record read.)

BY MR. FEATHERSTONE:

Q Where you say that the identification of the four chlorene dibenzofurans is tentative as 2,3,7,8, do you mean that there are interferences that prohibit

Thos L Urban  
Certified Shorthand Reporter  
134 South La Salle Street

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you from making a positive identification?

A There is no interferences that prohibit us from making a positive identification that is a tetrachloridedibenzofuran. The analogous situation existed for quite some time in the TCDD isomer specificity, and it was not until all of the isomers were synthesized and shown that they could be resolved that we could state unequivocally that 2,3,7,8 TCDD was present.

In the current state of research, no one has unequivocally identified 2,3,7,8 by unequivocal definition. However, it is known the compound present co-elute exactly with 2,3,7,8 TCDD on more than one column of widely different polarities. And based on reasonable scientific certainty we are certain that 2,3,7,8 is likely present, the high probability of being present.

I am well aware of research done at Monsanto that shows the possibility of one other isomer coeluting with 2,3,7,8 TCDD. And I think the intent of the report is clear. Biologically there is quite a bit of supporting evidence that would also substantiate 2,3,7,8 as being refractory.

Thea L Urban  
Certified Shorthand Reporter  
134 South L. Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

Q My first question is, because you said that the identification is tentative, does that not mean you have not been able to positively identify that four chlorene dibenzofuran as 2,3,7,8?

A With the qualification I stated, that on several analytical columns the material is coincident with it. We have not precluded that it is not.

Q In other words, you haven't made a positive identification?

A We have made a positive identification that it could be 2,3,7,8 TCDD, and that it is a tetra-chlorodibenzofuran.

Q But you have not made a positive identification that it is the four chlorene dibenzofuran 2,3,7,8, isn't that right?

A As I qualified the statement, I have identified it within the limits of our ability and the rest of the scientific community.

Q Dr. Stalling, have you been able to separate and positively identify all four chlorene dibenzofurans?

A No. No one else has.

Q Is it not true that because your laboratory has been unable to do that, you are unable to make a

Thos L Urban  
Certified Shorthand Reporter  
1000 10th St. S.W.

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positive identification that that four chlorene dibenzofuran in those fish in Exhibit 1, you are unable to say that they are positively 2,3,7,8 tetrachlorodibenzofuran?

A Within the limits stipulated, that is correct.

Q In your judgment, do dibenzofurans correlate with PCB levels?

A Yes, they do.

Q Would you expect that fish with higher PCB levels would have higher dibenzofuran levels than fish with lower PCB levels?

A That is correct.

Q Is that what your data in Exhibit 2 shows?

A No. There is no direct correlation with Exhibit 2 and dibenzofuran measurements whatsoever, because no dibenzofurans were made on those samples.

Q In Exhibit 1 -- I misspoke, I meant Exhibit 1. In Exhibit 1 does your data show that dibenzofurans correlate to the PCB levels in those fish?

A The information to make that statement is not present, because you do not have total PCB content. You have non-orthochloro PCBs reported.

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

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Q Are you aware that the US EPA measured those two fish reported in Exhibit 1 for total PCB?

A I have no data on that.

Q I want you to assume, Dr. Stalling, that according to the US EPA, the fish identified in Table 1 had a 131 part per million total PCB measured on a whole fish. Okay?

A Yes.

Q Okay?

A Okay.

Q I want you to assume the fish shown in Table 2 as measured by US EPA to have 187 parts per million PCB measured on a whole fish basis.

A 187?

Q Yes.

A Okay.

Q In both cases it is reported as PCB 1248.

All right?

A Yes.

Q With that data in front of you, is it true that your findings of the level of dibenzofurans in those samples do not correlate with the PCB levels in those fish samples?

## Stalling - direct (Featherstone)

A Well, the trend -- No, I don't think it's -- No. They tend to correlate with the PCB levels. If fish 1 has 131 and fish 2 has 190, that's 40 percent, almost 50 percent greater PCB content in our data, or the factor of 100 percent -- No, 50 percent greater, or 100 percent greater is a general correlation. It is not an inverse correlation for certain. I would say that a 20 percent or 15 percent error might be made in the measurement, since dibenzofurans are made without an internal standard reference compound such as the case with chlorene labeled TCDD. That the error there could be 20 percent. So if you take an error plus or minus 20 percent, we are not very far from a direct correlation.

Q Can you measure an expected level of dibenzofurans in a fish with 187 parts per million PCB measured as PCB 1248?

A To make certain, would you repeat the question?

Q Certainly. Are you able to make a projection as to the estimated concentration of dibenzofurans in a fish that has a PCB concentration of 187 parts per million measured PCB 1248?

A I could give you a range of expected value

Theo L Urban  
Certified Shorthand Reporter  
170 South La Salle Street

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based on monitoring data that we had done from other locations, yes.

Q What range can you give me?

A The mean value for about 25 samples, there are about, PCDFs would be approximately one 200,000ths to one 100,000th of PCB level.

Q What would that give me when applied to 187 parts per million PCB?

A About 40 parts per trillion.

MR. POPE: Based on 187?

MR. FEATHERSTONE: Yes.

BY MR. FEATHERSTONE:

Q In Exhibit 1, your laboratory reports measurements of five chlorene and six chlorene non-ortho PCBs for those two fish, in those two fish, is that correct?

A That is correct.

Q Did you look for those two non-ortho PCBs when you ran the analysis of the five sediment samples that are reported in Exhibit 2?

A Yes, and I believe that data is provided in the Appendix D.

Q Did you find five chlorene non-ortho PCB

Theo L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603



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in the sediment samples that you analyzed?

A No, we did not. We did not report it.

Q Did you find it?

A We found the peak that might correspond to it, but we did not have the mass spectrometry confirmation, so we did not report it.

Q Does that mean you could not identify it as a five chlorene non-ortho PCB?

A We didn't attempt to identify this.

Q Did you look for six chlorene non-ortho PCBs in the sediment samples?

A There was not a peak corresponding to that component in the sediment samples, is my recollection.

Q What you are telling me is you did look for it and didn't find it?

A That is correct, by electron capture gas chromatography, that is correct.

Q Do you have any explanation for why you found six chlorene non-ortho PCBs in the fish, or at least in two of the fish samples that are shown in Exhibit 1, but you did not find that in the sediment samples?

A There were two different quantitation methods

Theo L. Urban  
Certified Shorthand Reporter  
114 South La Salle Street  
Chicago, Illinois 60603

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reported.

Q What does that mean?

A In one case we did the analyses by mass spectrometry, which is more specific for the hex and penta compounds than is electron capture, with a much larger sample size. And in all the analyses we have done so far with the Aroclor series, the concentration as reported JAOAC article we wrote, the content of 3,4,3,4 is highest in 1248, and very small amounts of hexachloro exist in the Aroclor.

So its relative occurrence, the hexachloro compounds relative to the pentachloro would be low.

Q Let me see if I understand your testimony. Is it your testimony that the six chlorene non-ortho PCB is present at only very low levels in PCB 1248?

A Relative to 3,4,3,4.

Q Which is the four chlorene non-ortho PCB, right?

A That is correct.

Q Is the six chlorene non-ortho PCB present in Aroclor or PCB 1248 at lower levels than is the five chlorene non-ortho PCB?

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Certified Shorthand Reporter  
124 South La Salle Street

## Stalling - direct (Featherstone)

A Yes, it is. If present.

Q You mean there is some doubt in your mind whether the six chlorene non-ortho PCB is present in any quantity in PCB 1248?

A That is correct. It's a low -- it is a trace component in the Aroclor.

Q Do you have any explanation why in Table 2 of Exhibit 1 your people found a higher level of six chlorene non-ortho PCB than five chlorene?

A I think I can explain that. There are two different sampling preparation schemes used in the workup of samples for the mass spectrometry dioxins, dibenzofurans. We did not optimize the recovery of 3,4,3,4 in that procedure, because we were -- it carried through the procedure, but the recoveries can be 30 to 40 percent. So that this technique used in the mass spectrometry determination will underestimate the concentration of 3,4,3,4.

Q I didn't ask you about 3,4,3,4.

A I am answering your question.

Q I am asking you about -- I am looking at Table 2, and I am asking the six chlorene non-ortho PCB which is reported at a level of 300 parts per

Thea L. Urban  
Certified Shorthand Reporter  
1700 South 1st Street, St. Louis, Mo.

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trillion, is that correct?

A That is correct.

Q And the five chlorene non-ortho PCBs, which is reported at a concentration of 200 parts per trillion, is that correct?

A That is correct.

Q If I understand your testimony correctly, it is your judgment that in PCB 1248 the five chlorene non-ortho PCB is present at higher levels than the six chlorene non-ortho?

A That is correct.

Q What is your explanation for why in this particular fish sample you found higher levels of six chlorene PCB non-ortho PCBs than five chlorene?

A I can't explain that directly. That is just the way the data is.

Q Does that data suggest to you that some of the six chlorene non-ortho PCBs came from someplace other than Waukegan Harbor?

A That is a possibility. I can't explain. I can't answer your question.

Q In Aroclor 1242 and 1248, do you find higher levels of four chlorene non-ortho PCB than five chlorene?

A That is correct.

Theo L Urban  
Certified Shorthand Reporter  
1715 South La Salle Street

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Q Would you look at Table 1.

A Yes.

Q Do you report for that particular fish you found 4700 parts per trillion non-ortho five chlorene PCB, is that correct?

A Yes.

Q And you found 2300 parts per trillion non-ortho four chlorene PCB?

A Right.

Q Do you have any explanation for why in that case --

A I gave you --

Q Just a minute. -- you found more non-ortho five chlorene PCB than four?

A Yes.

Q Why?

A That is, the concentration 3,4,3,4 is underestimated by as much as a factor of two to three for this procedure. We reported what was present in the fraction analyzed for dioxins and dibenzofurans. And as I indicated, there is a difference in the separation procedure between that reported in the Appendix 2 and in your item 2 and item 1, Exhibit 1 and Exhibit 2.

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Ill. 60603

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Q Is there any reason why you didn't go back and run that using the correct procedure?

A Yes. It only cost \$6,000 or \$7,000 to do it, and it was not a specific objective of the analysis to begin with. We reported what was present in the sample.

Q Are you saying it wasn't a specific purpose to identify as precisely as possible the concentration of 3,4,3,4 non-ortho PCBs in the sample?

A That is correct, in this analysis, that is correct.

Q Is that generally true for all of the data reported in Exhibit 1?

A You only have two samples, and it was not a tailored procedure for total 3,4,3,4 determination. It was not optimized to give maximum recovery for 3,4,3,4. We wanted to confirm the identity of this material with known standards and mass spectrometry to be certain we were indeed measuring 3,4,3,4,3,4,5 and 3,4,5,3,4,5.

Q The work that you did that is now reported in Exhibit 2, did you make any effort to compare the levels of four chlorene non-ortho PCB that you found

Theo L Urban  
Certified shorthand Reporter  
174 South La Salle Street

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with what you expected to find in those samples?

A I have not.

Q You do not know whether it's high or low?

A I answered your question. I have not attempted to relate the concentration of those components to the Aroclor composition.

Q Is that worth doing?

A I don't know if I have an interest in doing it at this instant.

Q If you did do it, would it give you any scientifically useful information?

A That is speculation on both our part.

Q Wouldn't it tell you perhaps whether the 3,4,3,4 non-ortho PCB is degrading in the sediments of Waukegan Harbor?

A I think it would only confirm that 3,4,3,4 and non-ortho chlorene substitution in fish residues tend to be slightly lower than that what you would expect in the respective Aroclor mixture, and reported that in the JAOAC article on the composition of non-ortho chloro compounds. An article by Huckins and myself on lower levels, slightly lower levels of 3,4,3,4 in relationship to the total PCB content.

Thea L Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
CHICAGO, ILL.

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We know that to be, or at least assume based on the literature publication, that to be the result of greater circulation in the organism and less storage in fat. Greater physiological activity for that type of compound. So it fits in with what is known about the partitioning of those components.

Q What you are telling me is that with respect to non-ortho 3,4,3,4 PCB you had less of a concentration in the fish than you may have in sediments, for instance?

A That is correct, yes.

Q Well, with respect to the sediment data that is reported in Exhibit 2, does that data in your judgment show that non-ortho 3,4,3,4 PCB is degrading in the sediments?

A I have not examined it, as you asked earlier.

Q You haven't examined it in that light?

A Within that context, no, I have not looked at that.

Q Your laboratory has reported that PCB 1242 is disappearing more rapidly than PCB 1254 and PCB 1260, is that correct?

A Yes.

Thea L. Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
Chicago, Illinois 60603



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Q Is that finding consistent with an explanation that the isomers of PCB 1242 are biodegrading?

A Some isomers may be, yes.

Q Does that also include the non-ortho PCB in Aroclor 1242?

A I don't think data exists in that comparison, to make that comparison yet.

Q It is not your testimony that non-ortho PCB in 1242 don't degrade?

A Are you asking -- Repeat the question.

Q Is it your testimony that the non-ortho PCBs in PCB 1242 are not degrading?

A Thus far with respect to this data, I have not addressed that question.

Q Well, with respect to any other data, have you addressed that question?

A No, I have not.

Q So in your mind it is an unresolved question?

A Yes. But not totally uncharacterized in the literature.

Q Well, what have you seen in the literature that suggests that non-ortho 3,4,3,4 PCB is not degrading in the environment?

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

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A I was not addressing specifically and only 3,4,3,4.

Q Well, let's address 3,4,3,4 first.

A Well, 3,4,3,4 can be metabolized by virtue of it having two carbon atoms with no chlorenes adjacent to each other. The hexochloro compound would be much more refractory to degradation. Compounds having the same physiological attributes of 3,4,3,4 substituted in one chlorene in the ortho position would likely degrade very slowly, much more slowly. And yet they too have the same or if not similar physiological response in the organisms, and therefore have lower rates of degradation. So that there is some structure information pertaining to degradability that can be applied to interpretation of data such as these to begin to study that question.

Q Well, let us deal with 3,4,3,4 non-ortho PCB first. All right?

A Yes.

Q Just that. Is there anything in the literature that suggests that non-ortho 3,4,3,4 PCB doesn't degrade?

A No, there is nothing.

Q Indeed because non-ortho 3,4,3,4 PCB has

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two adjacent carbons that do not have chlorenes attached, you would expect them to degrade, isn't that right?

A That they can be degraded, yes.

Q Isn't it true that you would expect that the non-ortho 3,4,3,4 PCB would degrade faster than certain ortho PCBs, for instance the six chlorene ortho PCB?

A Right. And it would degrade less slowly than a lower chlorinated PCB such as 3,4,4 prime trichloro. There is a general correlation with lower levels of chlorination being very much degraded.

Q Is the fact that you did not find the six chlorene non-ortho PCB in any of the sediment samples you analyzed or any of the fish samples that you analyzed in the second round that are in Exhibit 2 consistent with an explanation that the six chlorene non-ortho PCB that you reported in Exhibit 1 are not from Waukegan Harbor?

A No. I disagree with your statement. There is no basis to make that statement.

Q So in your judgment that six chlorene non-ortho PCB that you find in Exhibit 1 had to come from

Thea L. Urban  
Certified shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60604

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Waukegan Harbor?

A If the rest of the PCB came from there, too.  
We are dealing with supposition.

Q The question is do you know that?

A No. You don't know either.

Q I am asking you whether consistent with an  
explanation that it did not come from Waukegan Harbor.

A No.

Q So we are at a Mexican standoff.

A That is the way it is.

Q Can you make any projections about the fate  
of non-ortho PCB in the sediment of Waukegan Harbor?

A Probably not.

Q Do you have any projection how much, if any,  
non-ortho PCB has been transported in the last year  
from Waukegan Harbor to Lake Michigan?

A I made no attempt to do that.

Q Is it your opinion that the particular non-  
ortho PCB that you have identified in the Waukegan  
Harbor samples have been generally found in fish in  
Lake Michigan for basically as long as PCBs have been  
in Lake Michigan?

A I assume there had been nothing -- Yes.

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60604

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Q Are you familiar with the work done by Dr. Humphrey?

A I have not -- No, I am not, not in any detail.

Q Do you know who Dr. Humphrey is?

A Yes.

Q Do you know he is a Government witness in this case?

A I have not had any contact with him. I may have heard the name.

Q Do you know that Dr. Humphrey did a study of people who ate large quantities of fish out of Lake Michigan?

A I have not.

Q Pardon me?

A I did not see it.

Q I haven't asked you whether you have seen it. Do you know whether he did that?

A No, I didn't know that he did that.

Q Dr. Humphrey did do a study of people who ate large quantities of fish in Lake Michigan, people who consumed in the neighborhood of 200 to 300 pounds of fish a year out of Lake Michigan, in some cases.

Thea L. Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
Chicago, Illinois 60603

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People who had been eating fish for 20 years or longer, fish with PCBs in them.

Is it your best judgment those people would have been eating fish containing these non-ortho PCBs that you found in Waukegan Harbor?

A I would almost assume with certainty that they have.

Q Are you aware that researchers have done work looking into the health of plant workers exposed to PCBs?

A Yes.

Q Is it your judgment that those plant workers who have been studied and reported on in the literature were also exposed to these non-ortho PCBs that you have found in fish in Lake Michigan and fish in Waukegan Harbor?

A I would have to know -- I am not sure I can answer that question. If I am not aware of the ortho -- the composition of PCBs that were exposed to the workers. But -- okay.

Q Assume that these workers have been exposed to 1242, 1248, 1254 and 1260. Is it your best judgment that those workers who have been reported on in these

Thea L. Urban  
Certified Shorthand Reporter  
114 South La Salle Street

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epidemiological studies were in fact exposed to non-ortho PCBs similar to what you found in Waukegan Harbor?

A Yes, I say so.

Q With respect to the dibenzofurans that you found in fish in Lake Michigan and Waukegan Harbor, is it your best opinion that individuals studied by Dr. Humphrey in his fish eaters study ate fish with the same dibenzofurans that you found in Waukegan Harbor and elsewhere?

A Yes.

Q Is it also your best opinion that those plant workers who have been studied have likewise been exposed to dibenzofurans that you found?

A No, not necessarily.

Q Well, you say no, not necessarily. So it is not a categorical no, is that correct?

A That is correct.

Q In some cases they may have been?

A Yes.

Q Are the non-ortho PCBs that you found in the sediment of Waukegan Harbor, and in some of the fish that you have analyzed from Waukegan Harbor, are they physically or chemically any different from the

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non-ortho PCBs that would have been in the fish that the fish eaters that Dr. Humphrey studied consumed?

A No chemical basis for any difference. A compound is a compound.

Q Have you made any study of the various alternative remedies proposed in this lawsuit?

A No, sir.

Q I want you to assume there are ten kilograms of PCBs moving from Waukegan Harbor to Lake Michigan presently on an annual basis. All right?

A Okay.

Q Assume that Waukegan Harbor is dredged so that there is no movement of PCBs from Waukegan Harbor to Lake Michigan. How much will that reduce the PCB levels in the fish found in Lake Michigan?

A I couldn't begin to answer that question.

Q How much will that reduce the non-ortho PCB levels in the fish found in Lake Michigan?

A I doubt that I can answer that question.

Q How much will that reduce the dibenzofuran levels in fish found in Lake Michigan?

A I wouldn't know the answer to that question,

Theo L Urban  
Certified Shorthand Reporter  
174 S. 11th St., S.W.



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either.

MR. FEATHERSTONE: What was the answer?

(Record read.)

BY MR. FEATHERSTONE:

Q I want you to assume there is approximately five kilograms PCB moving yearly from the North Ditch into Lake Michigan. Okay?

A All right.

Q Do you know what the North Ditch is?

A I have seen a map, yes.

Q I want you to assume that some remedy is implemented in the North Ditch so that there is no movement of PCBs from the North Ditch to Lake Michigan. Do you have any idea of what that would do to PCB levels in the fish found in Lake Michigan?

A No, sir.

Q Do you have any idea what that might do to the dibenzofuran levels in the fish found in Lake Michigan?

A No, sir.

Q Do you have any idea whatsoever what that might do to the non-ortho PCB levels in the fish found in Lake Michigan?

Thos L Urban  
Certified Shorthand Reporter  
174 South La Salle Street

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A No, sir.

MR. FEATHERSTONE: Let's take a break.

(Recess had.)

BY MR. FEATHERSTONE:

Q Dr. Stalling, is the presence of adjacent hydrogens on a PCB ring important in the degradation of sediment?

A I can't answer that question. It is an organism.

Q You can't answer that question because you are not aware of any data or research on that point?

A That is correct.

Q Does your data that is reported in Exhibits 1 and 2 show that the non-ortho PCBs are degrading more rapidly in the sediment of the Waukegan Harbor than other PCBs?

A We addressed that earlier. I can't answer that question. I haven't examined it.

Q Does any of your data from anyplace suggest that the non-ortho PCBs are degrading more rapidly than other PCBs?

A No, I think not.

Q Does your data from other locations show

Thea L. Urban  
Certified Shorthand Reporter  
124 South La Salle Street

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that they are not?

A No.

Q You just haven't analyzed that data in that regard?

A We don't have the information to answer your question. I do not have the information to answer your question.

Q Dr. Stalling, I asked you what effect a remedial action in Waukegan Harbor that cuts off the movement of PCBs from Waukegan Harbor to Lake Michigan would have on the PCB levels in Lake Michigan fish. You testified that you were unable to give me an answer. In other words, that you don't know.

What information would you need to be able to make such a determination?

A Well, I could only cite that from the literature viewpoint that the models that were described used a series of data, and you are privy to the same information I am, and I simply don't hold myself out as an expert limnologist, and don't feel qualified to get into that.

MR. POPE: An expert?

THE WITNESS: Limnologist. That is a guy

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

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who can do what you just asked to do.

(Discussion had off the record.)

BY MR. FEATHERSTONE:

Q Have you made a comparison between the levels of non-ortho PCB that you found in Waukegan Harbor fish to the levels in fish found elsewhere in Lake Michigan?

A As of yet I have not.

Q Do you have the data base to do that?

A Probably not in detail.

Q Do you presently have a data base to allow you to do that with the kind of scientific precision that you would like to have?

A Let me state in response to your question what could be done, or what has not yet been done, but could be done.

We have in these data composition by virtue of various degrees of ortho-chlorene substitution, starting primarily with the one chloro to four chlorene containing.

Q You have to keep your voice up, Doctor, so the Court Reporter can take it down.

A So that a distribution or composition analysis comparison could be made on the basis of these data with

Theo L. Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
Chicago, Ill. 60603

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respect to orthochlorene substitution, as well as substitution in the 3,4 position, specifically dealing with two chloro compounds which have 3,4 or 3,4,5 or 4 prime substitution. So the data exist in these analyses to make comparisons on composition. The data for the measurement of 3,4,3,4 is restricted to the Waukegan samples. That is what is in this Exhibit 2.

Q Bear with me, Doctor. Given the data base that you have, I take it you cannot now make a comparison between the levels of non-ortho 3,4,3,4 PCB found in the Waukegan Harbor fish samples with fish samples taken elsewhere in Lake Michigan?

A That is correct. In Exhibit 2 you cannot do that.

Q Is it likewise true, that for non-ortho PCBs in Waukegan Harbor fish samples that you cannot compare those levels with levels of the same PCBs in Lake Michigan fish found elsewhere?

A That can be done. We are restricted. Your first question restricts it to 3,4,3,4.

Q Yes.

A The second does not restrict it to any isomers

Theo L Urban  
Certified Shorthand Reporter  
124 South La Salle Street

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other than the non-chloro, non-orthochloro component.

Q My second question restricted it to non-ortho PCBs.

A That is correct. I believe that there is data to allow you to do that, if you so choose.

Q But you haven't done that?

A I haven't done that.

Q Do you have any plans to do that?

A I may.

MR. FEATHERSTONE: Mr. White, does the Government have any plans to have Dr. Stalling do that?

MR. WHITE: It may. I don't know.

BY THE WITNESS:

A I have not been asked to do it.

MR. WHITE: He hasn't been asked. It depends how many opinions he has.

BY THE WITNESS:

A When would you like to see that?

MR. POPE: Would it be a fair assumption to say that if he in fact does do that comparison for purposes of testifying, the Government will tell us?

MR. WHITE: Yes.

MR. POPE: Sometime before he takes the stand.

Thea L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street

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MR. WHITE: Certainly.

MR. FEATHERSTONE: Within a reasonable time period of his taking the stand.

MR. WHITE: Yes.

(Discussion had off the record.)

BY MR. FEATHERSTONE:

Q Dr. Stalling, what work have you done to prepare for your deposition, other than the analyses that are reported in Exhibits 1 and 2?

A What work? Define what you mean by work.

Q You don't understand the term work?

A Well, I want you to define it for me, so I don't misinterpret what you are asking.

Q Have you seen any data, any documents, talked to anybody concerning Waukegan Harbor?

A No, I have not talked to anyone concerning Waukegan Harbor other than what you have here.

Q Have you discussed your testimony with Elizabeth Stein?

A I have.

Q Have you discussed it with Mr. Hynes or Mr. White?

A I have.

Thos L Urban  
Certified Shorthand Reporter  
106 South La Salle Street

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- direct (Pope)

Q Have you discussed your testimony with anybody other than the attorneys for the United States of America?

A I have not.

MR. FEATHERSTONE: I don't have any further questions, Doctor.

DIRECT EXAMINATION

BY MR. POPE:

Q Would you please summarize what your opinion is as a result of all the work you have done in this project?

A I will attempt to do that. We have characterized the nature of the Aroclor residue in the representative samples, representative samples of sediment and fish.

We have demonstrated the integrity of the methods used to generate the data beyond a reasonable scientific doubt, in my opinion.

We have presented this information in two formats; one, which allows a comparison of composition in a general way with respect to the various levels of ortho prime substitution, which I personally believe to be important in terms of interpretation of the

Theo L. Urban  
Certified Shorthand Reporter  
124 South Main Street



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residue, significant.

We have presented the information on the dibenzofuran data that in general correlates with other analyses with ratio of furan and PCBs.

I think that summarizes what information we have generated.

Q Setting aside Exhibit 1, focusing instead on Exhibit 2, which I take it includes the appendices, does it not?

MR. WHITE: That is correct.

BY MR. POPE:

Q What were you asked to do?

A I was asked to analyze a set of samples to be provided by the Environmental Protection Agency for the composition on an isomer specific basis, and provide information on quality control validity of the measurements.

Q Namely whether in fact the results you find really were the isomers that you reported, right?

A The method of recovery and so forth were acceptable. Performance of the method, analytical criteria.

And to testify, I guess, in respect to the

Theo L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street

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integrity of that information and the results of those findings.

Q Is that it?

A I think that is it. I can't think of something else.

Q Make sure I understand. You were asked and it is your understanding that this is the limit of your job; analyze the samples. What are they, seven fish samples and five sediment samples?

A Right.

Q They were provided to you by somebody else?

A That is correct, by the Environmental Protection Agency.

Q Analyze those, and tell first the Government and then presumably the court or jury which isomers of PCBs were in those samples, correct?

A Right.

Q And be sure that you went through the proper process by some kind of quality control, is that right?

A That is correct.

Q Anything else?

A And I think in terms -- One implicit, along with that request, was to attempt to translate, if

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possible, any -- or to provide any assistance in interpretation and utilization of the information.

Q Give me your interpretation and utilization of that information? Summarize that for us.

A Okay. This is based on familiarity with the published literature and conversations with the researchers that work in the area of the PCB response in organisms. It goes back to the philosophy of this analysis. This is not unique. These analyses are not unique. There are probably ten laboratories in the world currently doing these on a routine basis.

Q Can you give us the names of those?

Q I can come close. I may not get them all. Dr. Ballschmitter in Germany; Dr. Steven Safe, Texas A & M; Dr. Mike Mullen, in Grosse Ile EPA; the Wallenberg Laboratory in Stockholm, Sweden; Dr. Rappe's laboratory in Umea, Sweden. Oh gosh, there are others. There is a laboratory in Japan. At this point in time I fail to recall the rest of these.

Q These are other laboratories that to your knowledge are doing the same kind of thing, namely taking samples from someplace they receive, and analyzing them for the isomer?

Ther L Urban  
Certified Shorthand Reporter  
100 South 1st, Suite 100

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A That is correct.

Q A particular PCB isomer, is that correct?

A Yes. Dr. Mary Wolfe at Mr. Sinai has also published work.

Q Now, I interrupted you. You were going to give me your interpretation of all of this.

A We have provided one report that is not currently in the literature, that is part of this document, that summarizes.

I will just refer to an example. We call them matrix reports. It lists the concentration of PCBs found in the sample, along with the fractional composition of those PCB isomers having those structural attributes. This is the way of dealing with the structure of the data, because these tables are relatively complex and not as readily discussed.

Q I never would have noticed if you had not told me.

A You never would have noticed that.

So we have devised a matrix presentation that allows you to look at the fraction of PCBs as a fraction of total, and tell you that of the 7.8 percent of the residue in such and such sample having one

Theo L. Urban  
Certified Shorthand Reporter

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orthochlorene PCB.

It is my belief that a toxicologist can deal with that information from the affects on the organism.

Q That is beyond your area of expertise?

A That is correct. That in a sense concludes what I have to say.

Q Is it fair to say that your job here is to take the samples, analyze them to determine the isomer involved, and summarize that isomer as you just showed me on this chart, right?

A Yes.

Q Period. End of job, correct?

A As I commented, though, earlier, if comments that are pertinent to the interpretation of the information I do feel free to make those comments.

Q Do you have any comments that are pertinent to the interpretation of the data that you intend to testify to, other than what you have testified to?

A I have alluded to the scope of what I intend to say.

Q Just now in response to my questions?

A That is right.

Ther L Urban  
Certified Shorthand Reporter  
174 South 1st, Suite 100

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Q You have no present intention to go beyond that? I don't want to keep you -- Dr. Stalling, I do not want to keep you here any longer than necessary. If that is the focus of your testimony, I just want you to tell me that is all you intend to testify to as of today.

A If appropriate, and if desired, if asked, I will respond in some detail pertaining to the isomer composition and its biochemical effects in terms of enzyme induction and structure activity relationships, because I feel I have a professional understanding of that area.

Q That area is one that you haven't clearly decided, you haven't talked to the Government about presenting testimony in that area, is that right?

A I am not sure I know how to answer the question. It has been discussed in general terms. But the specifics have not been developed.

Q Is that the area that was dealt with by Judge Getzendanner yesterday afternoon?

A That is correct.

MR. WHITE: I think, Mike, for the record, I don't want to be obstreperous here, but I am going

Theo L Urban  
Certified Shorthand Reporter  
124 South La Salle Street

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to object in the sense you are going to ask him an open-ended question like that, what his testimony is going to consist of. If you want to ask specific questions about the testimony, about the documents here, about what has been presented in the report, I have no problem with it. But to ask Dr. Stalling what all facets of his testimony are, I think is a little unfair and practically impossible under this type of a circumstance.

I direct your attention to the expert interrogatory, especially item D, which would deal with, and may refresh Dr. Stalling's recollection with respect to what he agreed to testify to for the United States.

MR. POPE: I don't believe Dr. Stalling expressed any lack of recollection as to what he has agreed to testify to. The thrust of my question is as he sits here today, what is his understanding of what is being asked of him. It seems to me to be a reasonable way to handle a discovery deposition to ask the witness what his testimony is from his point of view. You may well want to ask him 10,000 other questions. We have to deal with that ourselves

Theo L. Utter  
Certified Shorthand Reporter  
134 South La Salle Street

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through discovery in some fashion.

MR. WHITE: I don't want you to think that without any objection from me you are going to limit the scope of his testimony by asking an open-ended question and getting an answer in four or five minutes with respect to what the scope of his testimony is going to be, and the facets of that testimony.

MR POPE: No, I don't mean to restrict him in any way at all. If he wants to go into greater detail --

MR. WHITE: Ask the question.

MR. POPE: He can read the report into evidence, but that is not in English. Most of this report is numbers and charts, Jim.

MR. WHITE: Right. And he will explain that report in detail, and all questions that reasonably follow from that report, that are pertinent to this litigation as a result of his analysis and the questions he was asked by the United States to perform.

MR. FEATHERSTONE: Subject to the pending motion before Judge Getzendanner.

MR. WHITE: Subject to the pending motion.

THE WITNESS: Included --

Ther L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603



Stalling - direct (Pope)

MR. POPE: Just a second. There is no question.

To quote Jim White this morning, you may not have liked the witness' answer, but he gave it. I don't intend to respond to you on the deposition, on the transcript. I have asked him a question, he has given me an answer.

MR. WHITE: Fine.

MR. POPE: You have got your interrogatory answer, that he may not necessarily coalesce.

BY THE WITNESS:

A Your question, though, pertains specifically to the data, in terms of structure activity. In this report are analyses from the Greag Lakes proper on fish, and some other lakes. Subject matter pertaining to that data would seem reasonable in this discourse. That is there is data on PCB composition from this included beyond the Waukegan Harbor in this report, and I suspect that is fair game for questions.

BY MR. POPE:

Q Do you want to revise your past answer now?

A I would simply append to it that in terms of this environmental data that has been acquired and

Ther L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

Staling - direct (Pope)

presented, I think I covered that with the answer I gave you in terms of this data, its interpretation. If there are questions pertaining or subject matter pertaining to the other lakes, that would be pertinent to the interpretation of this, I would certainly feel it appropriate to comment.

Q Such as?

A Such as fate or distribution of PCBs in the other Great Lake system.

Q What opinion do you have with regard to the fate or distribution of PCBs in other Great Lakes?

A This goes back to comment pertaining to the structure activity and persistence. We only touched on one group of isomers through your direct questions. There are other structural related features which have not been discussed at this point, which may be relevant.

Q Such as?

A Such as the one chloro substituted PCB having 3,4 substitution.

Q What is your opinion or proposed testimony with respect to that?

A That they are of equal concern.

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Pope)

Q Where?

A In terms of hazards and/or biological response, particularly biological response. It poses one orthochlorene containing PCBs.

Q In what way of equal concern?

A They induce AHH, arylhydrocarbon hydroxylase.

Q Are you talking about in Lake Michigan?

The question was with regard to other Great Lakes.

A Other Great Lakes or fish or physiological responses of organisms, fish and/or other organisms to the presence of these materials.

Q Are these materials found in all the Great Lakes?

A They certainly are.

Q Are dibenzofurans found in all of the Great Lakes?

A Not all.

Q Which ones?

A Michigan, Huron, Ontario, Lake St. Clair, and low but detectible levels in Superior. So yes, they are found in all the Great Lakes.

Q The same for dioxins?

A No.

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Ill. 60603

## Stalling - direct (Pope)

Q Where are dioxins found?

A Lake Huron, and Lake Ontario.

Q Do you have an explanation --

A And a trace level in Lake Michigan, or a detectible level in Lake Michigan. Very low. We are talking specifically about TCDD.

Q Do you have an explanation to why the distribution?

A I have an opinion, yes, I have an opinion.

Q Would you give me your opinion?

A My opinion is that they were primarily introduced into the Great Lakes through chemical manufacturing and disposal of wastes associated with 2,4,5 trichlorophenol production.

Q To a layman, where is that substance used, in what product?

A Used in the production of two widely -- in herbicides, such as 245T, the herbicide, and hexachlorophene production, both of which are largely discontinued now.

Q Are both of them herbicides?

A No.

Q Pesticides?

Thea L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Pope)

A What is -- What is Physodex?

MR. WHITE: Disinfectant.

BY THE WITNESS:

A Physodex is used in hospitals as a disinfectant. It is made from 2,4,5 trichlorophenol.

BY MR. POPE:

Q Those two sources in your opinion are the primary source --

A Of dioxin.

Q In the various Great Lakes, is that right?

A Yes.

Q How about dibensofurans, your --

A My opinion is dibenzofurans are a direct consequence of PCB, just introduction into the environment, into the Great Lakes.

Q Let me finish the question. The other problem we make for our reporter is when two of us talk at once, it is even harder than when one of us talks fast. Okay?

A Yes.

Q What is that opinion based on?

A Based on analytical surveys done on the Great Lakes for fish; based on a thorough review of

Theo L Urban  
Certified shorthand Reporter  
124 S. La Salle Street  
Chicago, Ill. 60603

Stalling - direct (Pope)

the literature and the chemistry of PCB pyrolysis.

Q What do you mean by that last statement?

A Conversion of PCBs to dibenzofurans through thermal processes, burning and/or heating in just limited amounts of air.

Q Is that process one that you have observed in the literature?

A That is correct.

Q Can you list some of the major articles you rely on for your opinion in that regard?

A Dr. Christopher Rappe.

Q Slow down.

A Dr. Christopher Rappe in Sweden. The other person's name I can't recall is at the Wallenberg Lab in Stockholm. Dr. Otto Hutzinger. I believe that covers essentially 30 or 40 or 50 percent of the literature that you have asked about.

Q Could I ask, Dr. Stalling, if you would make available to Mr. White citations to the articles that you rely on for your opinion in that regard?

A Okay. They are available in the list of publications. The first reference, the book Chlorinated Biphenols, Renate Kimbrough's book covers

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603  
312-582-1110

Stalling - direct (Pope)

the major amount -- it is published by, it is cited as the first reference I think in the material.

Q One reference you are talking about now?

A There are some several hundred references cited in that.

Q I know. I understand. You could refer me to the Library of Congress, too. I want to know which references that you are relying on for your conclusions that you propose to testify to. That is my question.

A The references cited, the first reference in the book published by Renate Kimbrough.

And you will have next week's proceedings on dioxins in the environment in Kansas City. There is a three-day American Chemical Society symposium, and abstracts of that are available through the American Chemical Society.

Q Available already?

A That is correct, or will be as of next week. I don't know that they are free. They are not available before the meeting, but next week they will be available.

Q Are you telling me you are relying for your opinion on a presentation that hasn't taken place yet?

Theo L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

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A I have co-authored with people who are presenting information at that meeting, and they are colleagues for which I have abstracts and have participated in some research work.

Q Are those abstracts you have already produced?

MR. WHITE: I don't think so.

BY THE WITNESS:

A No -- Yes. You have my abstract from the meeting next week, I believe, that is correct. If not, they are available.

MR. POPE: I just want to make sure, Mr. White, that I have one way or the other the basis on which Mr. Stalling is forming his conclusion.

MR. WHITE: Yes.

BY THE WITNESS:

A The best source and most comprehensive source will be the American Chemical abstracts, American Chemical Society abstracts from the meeting next week, and they are printed and available at the meeting. So I know that I don't have the book in total.

Q I don't think I can make it next week, I

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603



Stalling - direct (Pope)

have a couple of other things to do.

Would you tell me, please, or summarize for us how this process takes place whereby dibenzofurans come from PCBs?

A This is an oxidation reaction which results in one of four mechanisms, and the net synopsis of it is one chlorine in the ortho position is generally replaced with an oxygen, and a bridge is formed between these two -- the biphenol rings, to produce the dibenzofurans.

MR. FEATHERSTONE: May I ask a question, not of the witness, but Mr. White. Is he going to testify about this at trial?

MR. WHITE: Structure of PCBs.

MR. FEATHERSTONE: No, no, no. Conversion of PCBs to dibenzofurans through pyrolysis? It is not identified in his interrogatory.

THE WITNESS: You asked --

MR. FEATHERSTONE: No, no. I am inquiring of your lawyer.

(A sotto voce discussion was had between Mr. White and the witness.)

MR. FEATHERSTONE: We are waiting for Mr. White.

Ther L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Pope)

MR. WHITE: Yes, I understand. I would have to say from my discussions with Dr. Stalling that this is not an issue that we expect to introduce through direct testimony. But we certainly feel that Dr. Stalling is capable of answering any questions that may be put to him by the court or anybody else during the course of the proceedings to answer that question as to how PCBs convert to dibenzofurans. But it is not, as I understand it at this particular point, to be the subject matter of direct testimony.

MR. POPE: Thank you. I have one more question in that regard and drop it.

MR. WHITE: I want to put on a qualification, Bruce. That this all, in my opinion this all falls in the realm of yesterday's discussion and the fact that Elizabeth is in China, and all that type of thing. That is my understanding at this point in time.

MR. POPE: Fair enough, fair enough.

MR. FEATHERSTONE: I will make the same motion or objection with respect to this line of testimony if you do intend to pursue it as I did with respect to toxicity and what-not yesterday. The reason I asked that of you, Jim, if you are going to

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

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tell me yes, he was going to testify to it, and it is not identified in the interrogatory, I was going to suggest we have another 4:30 emergency motion with Judge Getzendanner, because you have got to stop at some point.

MR. WHITE: Well, that is the statement.

MR. FEATHERSTONE: Sorry, Mike.

(A sotto voce discussion was had between Mr. White and the witness.)

BY MR. POPE:

Q Dr. Stalling, I only have one more question on that area. What temperature do you need to bring about that, in your opinion?

A 250 to 300 degrees C.

MR. WHITE: I have one comment on the record with respect to that.

MR. POPE: One more?

MR. WHITE: One more comment. Thank you, Mike.

It is our opinion that Dr. Stalling is certainly capable of testifying to that, qualified to testify to that particular area which we were talking about a moment ago, conversion to dibenzofurans

Theo L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

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from PCBs, and that it is covered in the interrogatory answer in the structure activity relationships section in item D.

MR. FEATHERSTONE: What does that interrogatory answer state?

MR. WHITE: That Dr. Stalling will testify to the chemical kinetics of PCBs, the process of uptake and elimination of PCBs in fish, the structure activity relationship of PCBs in regard to AHH, the presence of individual PCB components and isomers in the Great Lakes, the equilibrium and distribution of PCBs in Lake Michigan, and the composition of PCB residues in the Great Lakes.

MR. FEATHERSTONE: All right.

MR. POPE: There is a great deal of liberty you are taking in the interpretation of that to consider that answer to include the subject that he just raised.

MR. WHITE: Thanks for the editorial comment, Mike.

BY MR. POPE:

Q Dr. Stalling, is the level of dioxins that you have detected in the samples that were provided

Theo L. Urban  
Certified Shorthand Reporter  
132 South La Salle Street

Stalling - direct (Pope)

to you, are they comparable to what has been reported in the other Great Lakes that you have referred to?

A Let me refer to Exhibit 1.

No.

Q In what way?

A The Lakes Huron, Ontario have 2,3,7,8 TCDD explicitly. Lake Michigan has only a trace of TCDD. We did not detect TCDD here. We do find some traces of octochlorodibenzo dioxin, TCDD in other lakes, but the octochloro levels here are higher than what we might have seen elsewhere.

Q How about the same question with regard to dibenzofurans?

A The dibenzofurans in general are comparable to Lake Michigan, if not on the high side. But they are not as high as some other industrial sites.

Q In the Lake Michigan area?

A No.

Q What area?

A Huron and Ontario.

Q Such as what sites?

A Tittabawassee River, Saginaw Bay, Lake Huron, Love Canal, or Port Aransas, in that area, and Lake Ontario.

Ther L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Ill. 60602

## Stalling - direct (Pope)

Q Saginaw Bay is off what lake?

A Huron. Tittabawassee River, Saginaw Bay, Lake Huron.

Q And those places have reported findings higher in terms of dibenzofurans than you have detected in the samples in Exhibit 1, is that correct?

A Yes, that is correct.

Q How about the non-ortho PCBs that you have detected in the samples you have analyzed? Are those comparable to, lower than, higher than results that you have seen elsewhere in the Great Lakes?

A Earlier comments on that I said I do not have orthochlorene measurements other than for the Waukegan Harbor.

Q You do not have any other ones from other places in the Great Lakes?

A We have one set of data, we have the corresponding isomer specific analysis. But for 3,4,3,4 you have the data that we have from the samples analyzed.

Q For 3,4,3,4 you do not have comparable data from anywhere else, is that true?

A We have one other -- we have other data from

Theo L. Urban  
Certified Sheriff and Reporter  
170 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Pope)

some analyses done on the river fish.

Q By whom?

A We did one. That is published, and that is in the list of appendices.

Q What River?

A I think it's Ohio River, by recollection. You will find that information in the references.

Q What were the findings as to the study done on the fish from Ohio River?

A I am sorry, but I just can't recall.

Q You don't know whether it was lower or higher?

A I just don't recall that.

Q What data do you have from samples elsewhere with regard to these isomers?

A We have approximately 1,000 samples that have been analyzed from the Mississippi River.

Q That is it, nothing from the Great Lakes?

A You have the data from the Great Lakes.

Q Yes. But beyond Exhibit 2, you have nothing from the Great Lakes?

A You have the data we have available for these analysis.

Ther L Urban  
Certified shorthand Reporter  
134 South La Salle Street  
Chicago, Ill.

## Stalling - direct (Pope)

Q Dr. Stalling, listen to my question.  
Besides Exhibit 2 you have nothing from the Great Lakes with respect to these isomers, is that correct?

A That is correct.

Q Thank you, sir. Do you have any samples that you have analyzed from anyplace else besides these in Exhibit 2, the one sample from the Ohio River, and the various samples you have gotten from the Mississippi River? Do you have any others?

A Let's clarify the chemical we are talking about. We are talking about 3,4,3,4, four isomer specific analysis.

Q We are talking about 3,4,3,4 first.

A For 3,4,3,4 we have the data in the Exhibit 2 and one other data set.

Q And that is?

A In the publication from AOAC, Dr. Huckins and myself, on the composition of 3,4,3,4 in Aroclors.

Q I take it that was the first time you did that, is that correct?

A That is correct.

Q Has that work been duplicated since?

A You mean further?

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603



## Stalling - direct (Pope)

Q The work reported in that article.

A We have done nothing further than that.

Q Has anybody else? Anybody else duplicated your work?

A Yes. There has been -- I believe the National Center for Toxicology Research has done some analysis using the same procedures. The methodology is in place in probably 30, 20 labs, something like that.

Q The methodology is in place, and you know that because they published their results, is that right?

A In some cases, yes.

Q In which cases? The ones you listed for us before as the various labs around the world?

A Yes. Their procedures are very comparable to what we are reporting data from.

Q Were those names that you gave us, are those people that are doing the same analysis of fish samples?

A Biological examples, yes, fish, wildlife.

Q As well as sediment?

A I assume. I know the group in Sweden has done sediment analysis.

Ther L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
CHICAGO, ILL. 60603

## Stalling - direct (Pope)

Q What is the purpose of those, the people in Sweden when they did the analysis, was there a conclusion, or what was the intention of their research, as far as you know?

A To try to correlate -- My understanding is to correlate PCBs and the composition in dibenzofurans. Most of the work I am aware of has dealt with concern about dibenzofuran formation from PCBs.

Q Was that the thrust of your work here?

A No.

Q Here you were simply trying to identify particular isomers, is that correct?

A That is correct.

Q Now, you got the samples from somebody from the EPA, is that right?

A That is correct.

Q Who was that you mentioned?

A Chain of custody documents would substantiate that. I don't recall the person whose name appears on the document.

Q When you refer to chain of custody documents, what are you talking about?

A I believe that information is available in

Theo L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street

## Stalling - direct (Pope)

the system, and I don't know whether you have it or not, but there were chain of custody documents sent to me along with the samples from the Environmental Protection Agency.

Q Have you produced those?

A I don't know.

MR. WHITE: I don't know.

BY THE WITNESS:

A I assume they will. I know they are here.

BY MR. POPE:

Q I assume they will, too, if they are here.

I'd like to make a request for that.

MR. WHITE: Do you know if we haven't produced that, Bruce?

MR. FEATHERSTONE: You have not produced chain of custody documents that go to Dr. Stalling.

MR. WHITE: Okay. You want the chain of custody documents, right?

MR. POPE: If it's not too much trouble.

MR. WHITE: It may or it may not be.

BY MR. POPE:

Q How many people at your laboratory worked on this project?

Thom L. Urban  
Certified Shorthand Reporter  
174 S. 4th St., St. Paul, Minn.  
2-1111

## Stalling - direct (Pope)

A Two people besides myself.

Q Two others besides yourself?

A Yes.

Q What was their function?

A I think you will find that answer in this morning's discussion which goes -- Do you want me to go through it, repeat it?

Q If you could just summarize for me.

A Okay. Ted Schwartz is involved with the sample preparation and getting samples into the gas chromatograph and the computer generates the data, and he reviews, along with myself, the computer reports, transfers the information to data base computer, and we look at the calculations and concentration determinations.

Ted Schwartz is responsible for the concentration, injection of the samples in the gas chromatograph, and actually that is done by an automated system, and primarily getting the same information into the system.

Then Jim Huckins was responsible for the processing of the samples with the procedures delineated in the first short summary for the separation of the ortho unsubstituted PCBs from the bulk of the PCBs.

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois

Stalling - direct (Pope)

Q You prepared the report?

A That is correct.

Q How about the appendices?

A I prepared the appendices.

MR. POPE: I will ask the reporter to mark this as Exhibit No. 3 for identification.

(Said document was marked Stalling Deposition Exhibit No. 3 (OMC) for identification, as of 9/9/82, JKS.)

BY MR. POPE:

Q I would like to call your attention to Deposition Exhibit No. 3 for identification, and tell me what that is?

A That is some additional information that was not available at the time that I typed the report, and made it available. This information was obtained while I was here in Chicago a week ago, whatever it was, in regard to the source of these samples and the data. We did not have the results from the Great Lakes Fishery Laboratory until our report was filed. That information was obtained through a call to Wayne Wilford at the Great Lakes Fisheries Research Laboratory. I wrote it out in longhand, and it was typed here in this office.

Theo L Urban  
Certified Shorthand Reporter  
174 South La Salle Street

Stalling - direct (Pope)

Q Here in the United States Attorney's Office?

A That is correct, because I didn't have the information prior to -- this was sort of a double blind check on our methodology.

Q In what sense?

A We did not know the results of the analysis. We analyzed those samples without knowing their previous analysis. They were analyzed at the Great Lakes Fishery Laboratory, and we wanted to verify that we got the same data, same total PCB concentration with the isomer specific analysis as what would be obtained by doing packed column analysis, packed column gas chromatography analyses. The results show equivalent -- I mean agreement between the two procedures.

Q You got this by calling whom?

A Wayne Wilford, who is in charge of this set of data.

Q Referring to Exhibit 3?

A That is correct.

Q Were they in the process of doing these studies?

A No.

## Stalling - direct (Pope)

Q Or they had already done them?

A I didn't want the information until we completed our analyses.

Q Am I to understand that that was your intention from the beginning not to have that data until afterwards?

A That is correct.

Q Now, in what way does this correlate or substantiate your analyses?

A Okay. What we did was to analyze two sets -- They had previously analyzed this one large composite sample 64 times to be exact.

Q What is a composite sample?

A They went out and caught 20 adult lake trout, no greater than 615 or 50 millimeters in length, ground them all up, composited it and made a gigantic fish.

Q Obviously the whole fish.

A Whole fish.

Q Different types of fish?

A No. Same age, size and sex. So subsets of this --

Q This was in the fall of 1979?

Ther L Urban  
Certified Shorthand Reporter  
1111 S. La Salle Street  
Chicago, Ill. 60607

## Stalling - direct (Pope)

A That is correct. Subsets of that sample were taken by their laboratory and run routinely with other sets of their own samples.

MR. FEATHERSTONE: You have to slow down, Doctor.

BY THE WITNESS:

A That large sample was broken into smaller sub-aliquotes of the sample and used for quality control purposes. We asked them, I asked them to send me four samples of unknown origin. I said to send me four samples for which you have data, and I want to analyze them along with these data as a performance check to establish if the results we generate from this isomer specific analysis were individual PCBs or some together to give a total concentration is equivalent to the determination that they do were packed column chromatography and a number of components are merged together.

Q Did you get the four samples at the time you got the various other samples from the US EPA?

A No. The EPA did not send the samples. Wayne Wilford sent them directly to me. They are not part of EPA's samples.

Theo L. Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
Chicago, Illinois 60603



## Stalling - direct (Pope)

Q When?

A I am sorry.

Q When?

MR. WHITE: When, when?

BY THE WITNESS:

A You mean when did I receive the samples?

BY MR. POPE:

Q Yes.

A I would have to check my laboratory records, but within a week of the same.

Q Either before or after you got the other?

A I don't remember. Essentially at the same time we had the other samples.

Q All right. Go ahead.

A And we undertook the analysis of those four samples right in with the block of data analyzed from the monitoring program data, and I included the results. This report was made on the weekend. Okay?

Q Exhibit No. 2?

A That is correct. Exhibit 2 was prepared, transmitted up here and dispersed to you people. I came up shortly thereafter and called -- at that time I realized we had not included those data in this

Thos L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Pope)

report, identified those samples. So to provide you with a full set of information, I called Wayne Wilford, asked him by the phone to give me their results, after having completed these analyses, and those are the results of the comparisons.

I called him a second time to cross-check that his numbers were those reported after the preparation of this report, and that information is correct.

Q How did those numbers correlate to the numbers you found?

A They are identical on the average of the four samples.

Q The average is identical or the individual --

A The average of the four samples is identical.

Q How about the individual?

A They are probably plus or minus 15 percent, ten percent.

Q Is that a common finding in your experience?

A That is acceptable.

Q Fifteen percent variation either way?

A Yes. I judge it to be very good.

Q Would we be fair in taking that same degree

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Pope)

of variation in terms of the rest of the analyses in Exhibit 2?

A I think that is a good estimate, yes.

Q Plus or minute 15 percent?

A Right, for total.

Q Is this number here on Exhibit 3, "They were extracts of subsamples of a large composite sample prepared by grinding and mixing tissue from 20 adult lake trout (7620 MM)" is that millimeters or is that supposed to be something else?

A That is greater than 650.

Q 650 or 615?

A 650.

Q Where did you get that information?

A That came from Wayne Wilford.

Q So that was typed in error?

A That was typed in error, yes.

Q Any other typographical errors that you detected in review of Exhibit 2?

A Environmental Protection Agency isn't capitalized in the table.

MR. FEATHERSTONE: It shouldn't be.

BY MR. POPE:

Q Any others?

Theo L. Urban  
Certified Shorthand Reporter  
110 S. 11th, 11th Floor  
Chicago, Ill. 60601

## Stalling - direct (Pope)

A There is one sample identification clarified in that appendix.

Q Exhibit 3?

A Yes.

Q Any other errors that you detected?

A Not that I am aware of.

Q These fish in this general Great Lakes Fishery Laboratory Study were collected near Saugatuck, is that correct?

A That is my recollection.

Q Is that a commonplace for them to gather their fish?

A They have had a sampling station -- it is my understanding they have had a sampling station there for some time. But I don't have the information at hand on that.

Q As a matter of fact, that is a source of PCBs there, is it not?

A I don't have specific information on that.

Q Do you have any information on the various sources of PCBs to Lake Michigan?

A Only by approximate reading -- or readings from the literature, various sources have been identified.

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Pope)

But I have not investigated inputs, known inputs.

Q Can you identify for us today any sources that have been identified as sources of the PCBs to Lake Michigan?

A Vaguely from recollection of the literature.

Q Perhaps you can give us your recollection, vague as it is.

A It's thought to be from the south end of the Lake, or from inputs from the Illinois River, I am certain of that. And beyond that I really can't recall specifics of inputs. I simply have not reviewed that information recently and don't have it in my mind.

Q Are you aware of any sources at Kalamazoo, Michigan?

A I have not investigated that.

Q Have you investigated any sources of PCB to any of the other Great Lakes?

A Yes.

Q Which ones are those?

A We have by analysis of samples from Saginaw Bay, the Tittabawassee River, and Love Canal or Tyuga Creek and -- what is the river between Lake

Ther L Urban  
Certified Shorthand Reporter  
174 South 10th Street  
Chicago, Ill. 60603

Stalling - direct (Pope)

Ontario and Superior -- Niagara River.

Q What is the source there?

A The dump sites, industrial dump sites in the Love Canal area, Tyuga Creek and one other creek there.

Q You are talking about three different sources to Lake Huron?

A In Lake Huron, Saginaw Bay, by virtue of the Tittabawassee River input, the Grand --

Q Where do PCBs come from there?

A I would have to speculate.

Q What is your best speculation?

A Dow Chemical Company.

Q From what plant? Is there a plant there?

A Yes, on the Tittabawassee River.

Q That was one?

A Right. One other recollection I have is there was a source of PCBs from the Grand River.

In the case of Lake Ontario -- No, not Lake Ontario. Lake Ontario, the easternmost Great Lake, the Niagara River I think is the major input.

Q What is the source there?

A The dump site, Love Canal, general area.

Theo L. Urban  
Certified shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Pope)

Love Canal and the related dump site not too far from there.

Q What product contained PCBs was dumped there, as far as you know?

A I am not certain of the materials. Looks like 1254 by recollection.

Q Any other sources of the Great Lakes that you are familiar with of PCBs?

A Direct input?

Q Yes.

A Not that I can recall. Those are what I considered to be major inputs into the Huron and Ontario.

Q When you say direct input, you mean as opposed to atmospheric?

A That is correct.

Q Did you make any assumptions with respect to the fish samples that you did as to where those fish acquired the PCB traces that you found?

A None whatsoever.

Q It is not necessary to your findings that PCBs came from the Waukegan Harbor or anywhere else, is that correct?

A That is correct.

Ther L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street

Stalling - direft (Pope)

Q I suppose you have a little harder discussion on the sediment.

A Yes. Want to debate that?

Q You made some references to the National Pesticide Monitoring Program, is that right?

A That is correct.

Q Can you describe that for us, please.

A Yes. The National Pesticide Monitoring Program was established as one of the operations I think of the President's Cabinet Council on Environment back in about 1967 or 1968, approximately. Responsibility for that program were given to a number of federal agencies, of which Fish and Wildlife Service, Department of Interior got the fish and wildlife monitoring segment.

The Department of U.S. Geological Survey, I believe, got the water monitoring results.

Our laboratory was involved with the fish monitoring operations as early as 1969 as a cross-check for laboratories. At those times the samples were done by contract analysis through various commercial laboratories.

Q Was there a whole bunch of laboratories

Theo L Urban  
Certified Shorthand Reporter  
114 South 13th Street



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besides yours?

A Yes.

Q You were acting as a check?

A We were acting as the cross-check function in the earliest time of the program. In 1974 or 1975 the laboratory proper assumed the responsibility of conducting those analyses on site.

Q Exclusively, your laboratory?

A That is correct. Along with cross-checks from the Great Lakes Fisheries Laboratory. There was a quality control program initiated, independent part of that operation, and since that time -- at that time I was responsible for the analyses for --

Q In the beginning of 1975?

A Yes, in 1975. The chemistry section did that for a very brief time.

Then the field laboratory program in our laboratory undertook the responsibility or was assigned the responsibility with the chemistry program that I operate acting as the confirmation for structure identity in search for new or unrecognized contaminants.

Since that time publications from the results from that is in the Pesticide Monitoring Program

Ther L Urban  
Certified Staff and Reporter  
100 South 1st, Suite 100  
Chicago, Illinois 60603

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Journal for 1974, early 1974, and there is a manuscript in preparation -- a manuscript has been accepted for publication in the Pesticide Monitoring Journal by Chris Smith, summarizing the results from 1974 to 1979. And analyses are currently ongoing in the laboratory for the 1981, 1980-81 collection period.

I think that is as concise a summary as I can give you.

Q For how long a period of time were you in charge of this monitoring?

A I was in charge of the cross-check program from the time we were asked to do it in 1971 or 1972, in the seventies, until 1974 or 1975. Then the field laboratory people -- A program was established to do field investigation in our laboratory, and one of their responsibilities was they were given monitoring analysis, and we set up -- I and related chemists set up the transfer to analytical protocol and training to get that program in operation in the other division.

Since that time, I have had confirmation responsibilities for DDT, TCDD, and PCBs.

Q So basically the two substances you looked

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Pope)

for in that program?

A No.

Q What else?

A The comprehensive organochlorene scan.

Q Has it always been that way?

A Essentially since we had it in 1975.

Q What about before that?

A It was done on a contract specification list to look for these compounds.

Q Do you know the first year that PCBs were added to that list?

A Probably 1971, approximately 1971.

Q When this process was in, when your people were doing it full-time as opposed to the prior cross-checking, were other people gathering samples and submitting them to you and your lab?

A The samples, no.

Q How did the process work?

A There was protocol established for sample collection in the Fish and Wildlife Service, where individuals were assigned the responsibility for collection of the samples at specified locations. Those locations are set out in the first publication

Ther L Urban  
Certified Shorthand Reporter  
24 South L. St. St. Louis  
MO 63103  
282-5517

Stalling - direct (Pope)

A Primarily in the Great Lakes and New York River -- Hudson River, Chesapeake Bay, Tittabawassee River, and I can't think of the river I mentioned earlier this morning in Connecticut.

Q Any others?

A There are about 100-some samples we have analyzed in different locations.

Q One hundred different locations?

A No. One hundred samples from 50 locations.

Q Would it be fair to say over this period of time dibenzofurans have been detected in approximately 50 different locations?

A Greater than 20 and less than 50. I don't know.

Q Would those all be in fish samples?

A Yes -- No, no, no, no, not all fish samples.

Q What other kind of samples?

A Sediments, turtles and fish.

MR. POPE: Let's take five minutes.

(Recess had.)

BY MR. POPE:

Q Do I understand correctly that Exhibit 1 was part of an overall national survey of some sort?

Theo L. Urban  
Certified Shorthand Reporter  
174 South 1st Street  
Chicago, Illinois

## Stalling - direct (Pope)

A It was part of a -- Yes.

Q Can you describe that, please?

A In 1974 I met Christopher Rappe in Sweden, and we discussed the fate of PCBs in the environment and said --

Q That means degradation?

A What happens, and the chemistry of PCBs in the environment.

Q What is going to happen to them?

A Yes, or what might have happened to them. We said it would be interesting and perhaps not technically useful to undertake a survey for dibenzofurans. And the literature --

Q You said this idea came in 1974?

A Right, right.

Q Okay.

A At the Helsinki International Pesticide Conference. At that point we sat down and specified what would have to be done to do those analyses. From that time we evolved a research program to investigate and determine the concentration of dibenzofurans and dioxins in aquatic organisms. The first publication from that effort came into articles

Thea L. Urban  
Certified Shorthand Reporter  
123 South La Salle Street

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published in Nature 1981, the journal Nature, in which we examined a snapping turtle from the Hudson River and the Baltic Sea and said dibenzofurans exist in the aquatic biota.

Prior to that time, six or eight publications had attempted to measure those compounds without success, based on two problems; sample workup and detection. Dr. Rappe and Dr. Buser's work is well renowned I guess in the area of detection and identification. And we feel we have made a contribution to the methodology for isolation of a whole series of compounds having structural attributes and biochemical responses. That is, there is a great deal more generalization that is possible for certain groups of compounds than what you might first suspect. Part of this then resulted in the actual doing of a series of dibenzofuran measurements, and dioxin measurements to figure out whether we had a dioxin problem or dibenzofuran problem on the national scene in the aquatic environment.

Q A national or international?

A It included some samples from international. We had samples from Lake Zurich, the Baltic Sea, some

Thea L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

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fish from the river in the northern part of Sweden, and a lake high in the mountains in Sweden, and the Great Lakes and rivers and so forth.

It's a very demanding project, but I think it established that we do have dibenzofurans in the environment, and that we have some specific places with dioxin contamination. And that result has been submitted to publication in the Second International Symposium on Dioxins and Related Compounds in the Environment held in Arlington, Virginia two years ago. We are still finalizing some segments of that report on this effort.

Q Is it your conclusion that there is in fact a dibenzofuran nationwide problem?

A Yes, it is.

Q That opinion is based on the studies that you have been doing since 1974, is that right?

A That is correct.

Q Was the methodology available in 1974 to --

A No, it was not. I am sorry.

Q -- to measure for dibenzofurans --

A No.

Q -- in the environment?

Thom L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street

## Stalling - direct (Pope)

A No.

Q When was that, when did that become available, to the best of your recollection?

A About 1979 or 1980, in the biota.

Q I take it the first five years of your efforts at measuring dibenzofurans were relatively scarce?

A No. We just didn't have the technology developed.

Q Is that why the first article came out in 1980?

A That is correct.

Q Now, my question was this was part of an overall survey, is that right, Exhibit 1?

A Yes.

Q Can you tell me -- You have given us a nice recount of the history of how you got interested in the subject. But how does this fit into a national survey or study?

A A very simple question -- answer to the question, question and answer. The director said, "Is this a real problem?" And I said, "I don't know." And he said, "Find out." And I did.

Ther L Urban  
Certified Shorthand Reporter  
134 South L. Salle Street  
Chicago, Illinois



## Stalling - direct (Pope)

And now then we hope to undertake study to determine toxicology of these compounds and the implication to the aquatic resource.

Q You say you did find out. How did you go about finding out?

A By development of analytical methodology to generate residue data.

Q What did you do to get the samples you needed, in general?

A They were collected from both the National Pesticide Monitoring Program. And a number of people were aware we were doing these analyses, and we had more samples than what we could attend to. So we selected samples based in part on information pertaining to either PCBs or lack thereof.

Does that answer your question?

Q Have you uncovered evidence of dibenzofurans in any samples that did not contain PCBs?

A None whatsoever.

Q Can you explain to me how this Exhibit No. 1 came about, what the circumstances were and prior discussions with respect to them?

A That is somewhat vague, due to some time.

Theo L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Ill.

Stalling - direct (Pope)

But as I recall, EPA through a conversation I believe I mentioned with Gil Veith said, "Samples were available. Would you include them." And we said yes, we will include them. So we got the samples as a consequence of an initial discussion, very brief discussion with Gil Veith.

Q Is it your recollection that the impetus was with Mr. Veith rather than with your laboratory with respect to this Exhibit No. 1?

A No. I think we had talked -- We had many other common problems and confirmation of environmental residues, one of which was toxins in residues. It was probably through that context that he was aware, as are a number of other people, that we were doing surveys for furans. I don't recall whether I asked him or he asked me, but I do remember a telephone conversation in which he indicated samples were probably available. And I remember saying, "Well, if we can get them and have a source of sample history on them, we will consider them."

Q Are you aware of any indications prior to May of 1981 of the presence of either dioxins or dibenzofurans in Waukegan Harbor?

Ther L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Pope)

A No, I am not.

Q What?

A No.

Q Did Mr. Veith mention to you that possibility?

A I don't recall.

Q What does this sentence on the footnote refer to, "Numbers in parentheses are the detection limit at a signal to noise levels of 3." What does that mean?

A What it says is that we would -- We have provided information at that point on what the information, what the sensitivity of the instrument was. That is if the value was ten parts per trillion -- let's just look at it. It says we could detect two parts per trillion for this series of compounds, and ten parts per trillion for this series of compounds. That was saying that a residue value of ten here would be three times the signal to noise ratio. A discernible response, but not -- subject to some greater errors. What you try to do is say what the limit of measurement with respect to good solid data, I guess. You can have a positive response, but not --

Q I see.

Ther L Urban  
Cent Find Street and Reporter  
134 South La Salle Street  
CHICAGO, ILL. 60603

## Stalling - direct (Pope)

A Highly quantitative.

Q Would I be correct in assuming then that a finding of 2, for example, at the detection limit of 2, would be more suspect than one where there was a higher degree of confidence, is that right?

A That is correct.

Q And ND is obviously non-detectible, is that right?

A That is correct.

Q At the risk of dragging this out any further, this indication here on table 2, 2 plus 7 plus 19, is that a finding for each of three isomers?

A That is correct.

Q What did you do with this report after you prepared it up, Exhibit No. 1?

A Transmitted it to EPA, and the data included in some other tables and publications that we have.

Q Who did you transmit it to? Is this an indication on here of the actual copies of people you sent it to?

A I am sure it is. Internal, but there is -- Curtis Ross is the person with whom I transmitted it in EPA, is the best recollection I have.

Ther L Urban  
Certified Shorthand Reporter  
174 South 1st City Street  
St. Paul, Minn.

## Stalling - direct (Pope)

Q Curtis Ross?

A Ross, R-o-s-s.

Q Where is he?

A That is internal distribution there.

Q The cc's listed here on page 1 are internal?

A No, I don't -- those are not -- This is something added.

Q The cc copies indicated is for a later date in time, is that right?

A Yes. 1/15/82. I think this is EPA's distribution list here. I don't believe this was part of my -- This is something that EPA added to the carbon copy.

MR. WHITE: I believe Dr. Stalling this morning, Mike, testified, maybe before you came, that there was a cover letter to this, and Curtis Ross is the head of the Central Regional Laboratory for EPA, as I understand it.

BY MR. POPE:

Q And that was shortly after November?

A Yes. I think it was transmitted within a few days of that date on the report.

MR. POPE: The cover letter was produced?

Theo L Urban  
Certified Shorthand Reporter  
14 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Pope)

MR. WHITE: I don't think so. I don't know.

BY THE WITNESS:

A I don't think so.

MR. WHITE: I don't even know if it exists.

I haven't even seen it.

BY MR. POPE:

Q Didn't you keep a copy of the cover letter?

A I am sure it exists.

Q Would you make it available to Mr. White?

A If it is available. I am sure there is a transmittal letter.

Q Thank you. Does Exhibit 1 record all the information you have or had as to the samples, such as where they were taken, what condition they were kept in, when they were taken?

A As far as I know, that is correct.

Q Basically you weren't provided with very much information?

A That is correct.

Q Do I understand correctly that you testified this morning that that factor is not very important to you in doing the kind of study that is exhibited here in Exhibit 1?

Ther L Urban  
Court Reporter  
100 South 1st Street

## Stalling - direct (Pope)

A To me it is not.

Q Would it matter the condition that the sample was maintained from the time it was first taken until the time it was transported to you?

A Yes.

Q Such as contamination would make a big factor in your result, would it not?

A Letting it thaw out might affect it, or degrade. But the samples were received in good condition, frozen.

Q Well, all right. Did you take any steps at all to determine what condition they had been in before you received them?

A I have no information.

Q You took no steps, right?

A Well, yes. We did take some precautions in specifying transmission of the samples. They were to be put in glass bottles and protocol to minimize any possible contamination.

Q But my question was you don't know what steps or precautions were taken by EPA or the person that collected the sample prior to it being turned over to you?

Thea L. Urban  
Certified Shorthand Reporter  
M.C., A.L., S.L., S.S.

## Stalling - direct (Pope)

A I can't comment on that. I have no information.

Q You weren't given any representation by Dr. Veith or anybody else, is that right?

A No.

Q The answer is yes, right?

A Yes, I assume so.

Q Is this the normal format that you use in your survey to report on studies such as this?

A I would say it is a very abbreviated report.

Q Why is that?

A This information was being contained in a scientific publication, being presented in a scientific publication, and was provided to inform them of our findings specifically, and does not contain extensive specifications on the particulars of the methodology. That was handled by transmission of reprints of the research protocol that was used.

Q I see. You provided Mr. Veith with the --

A No, no.

Q Mr. Ross?

A Yes.

Q With the reprints?

A Yes.

Ther L Urban  
Certified Shorthand Reporter  
1015 S. 1st St., St. Paul, Minn.



## Stalling - direct (Pope)

Q Of the entire survey, is that right?

A Yes.

Q Did this play a part in -- This didn't play a part in the 1980 survey?

A No. I'd have to check the specifics of it, but it was part of the whole project which began in 1975 or so. We had one project on surveys.

Q The information, the data here in Exhibit No. 1 has been included in a published abstract or survey, is that right?

A As far as I recall, it is part of the presentation that was made at the International -- Second International Symposium on Dioxins and Dibenzofurans.

Q When was that?

A In October of 1981, Arlington, Virginia.

Q This document, Exhibit 1, bears a date of November 25, 1981.

A Yes.

Q Is it your recollection that the data contained herein was presented as part of that program in October of 1981?

A It probably was, but I can't be certain of

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street

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that chronology. We would have to look at the specific report.

Q Was there anything about the date of that presentation that caused this report to be an abbreviated form?

A I can't recall specifics.

Q At the time you did this report, were you aware of any litigation involving Waukegan Harbor?

A No. Well, I guess I should rephrase that. Yes, I was aware there was some litigation, but I think that is about as much information as I had on it.

Q Were you aware of any intention by anyone to use your work in connection with the litigation at all?

A No. It was not stated, nor was I, you know, nor was any -- nor was I aware that it would be, explicitly.

Q With respect to the remaining, to the other samples that you included in your basic survey publication in October of 1981, did you have any more information than you had here as to the collection of those samples and the condition in which they were

Ther L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Pope)

stored before they were received by your laboratory?

A No, as I indicated previously.

Q Does your laboratory do work exclusively for the United States Government agencies?

MR. WHITE: Mike, this whole area of inquiry, you know, has been asked and answered. Bruce went through it this morning in great detail at the very beginning of the deposition, for about 20 minutes.

MR. POPE: I was under the impression you hadn't gone into that.

MR. FEATHERSTONE: I didn't.

MR. POPE: I don't think that question was asked.

MR. WHITE: Go ahead.

(Discussion had off the record.)

BY MR. POPE:

Q I think the question was with respect to Government projects.

MR. WHITE: Go ahead.

BY THE WITNESS:

A In answer to -- State your question, just so we start off clean here.

Thos L Urban  
Certified Shorthand Reporter  
24 S. 1st St., St. Louis

## Stalling - direct (Pope)

BY MR. POPE:

Q Does your laboratory do work exclusively for United States Government agencies?

A No.

Q Who else do you do work for?

A We have had cooperative projects with Wood Preservative Institute, the American Chemical Manufacturing Association, Monsanto Chemical, Dow Chemical, and probably numerous other chemical companies, between pesticide manufacturers and so forth.

Q On any of those projects have you been involved personally?

A Yes.

Q On any of those projects that you were involved, was the subject matter of the project related to PCBs?

A No.

Q Did it relate to hydraulic fluids, any of the projects you worked on?

A Yes.

Q How many projects were there?

A Pydraul is one specific hydraulic fluid that I can remember.

Ther L Urban  
Certified Shorthand Reporter  
134 South L. Salle Street

## Stalling - direct (Pope)

Q Would you describe that work you did, and what the project was?

A That was a cooperative research project with Monsanto Chemical, St. Louis. I believe the parties involved were Richard Kimberly, by recollection, and it was an evaluation of a phosphate ester as a potential PCB replacement.

Q FDE?

A I believe that is correct.

Q What were you asked to do?

A We were asked to chemically characterize the composition of this material, also in cooperation with the biological testing to determine degradation rates pertaining to the various crystal phosphates substituted esters and phenyl esters, and to assist in recommending alterations in the composition of the material so as to decrease its toxicity to aquatic organisms.

Q Approximately when was this project undertaken?

A 1979 to 1980. About 1980, but I -- that is the closest recollection I have. Dr. Mayer in our laboratory was one of the authors on some of the publications.

Q And the result of that study were published?

Ther L Urban  
Certified Shorthand Reporter  
174 South La Salle Street

## Stalling - direct (Pope)

A I believe so. I'd have to -- That is beyond my recollection at this moment.

Q Did that study have anything to do with analyses for or findings relating to dibenzofurans or dioxins?

A No, sir.

Q Can you tell me what other projects that you have worked on with private industry or American Chemical Manufacturers Association relating to PCBs?

A I indicated there were none.

Q Have you worked on any such projects related to dibenzofurans?

A Yes.

Q Would you describe for me generally speaking how many?

A One project, by recollection.

Q What was that?

A That was in relation to the American Wood Preservative Institute, to characterize whether pentachlorophenol was less toxic than industrial composites known to contain chlorinated phenoxy phenol, which is a condensation of two phenols. Those are sometimes referred to as pre-dioxins or isodioxins.

Ther L Urban  
Certified Shorthand Reporter  
174 S. 4th St., St. Paul, Minn.

Stalling - direct (Pope)

Precursors to dioxins for thermal cyclization.

I guess -- I guess the conclusions were that industrial materials containing these impurities were more toxic than pure pentachlorophenol. That was done in the context of Dow Chemical's Dow Therm. I believe, I am not sure. It is a pure pentachlorophenol.

Q With the exception of the project you have just referred to <sup>ON</sup> 50E, are you aware of any other projects that your laboratory has worked on in conjunction with Monsanto Corporation?

MR. FEATHERSTONE: I am sorry, would you repeat the question.

(Record read.)

BY THE WITNESS:

A Yes.

BY MR. POPE:

Q Can you tell me what those are?

A We did a research study in 1976 to 1977 someplace, about in that, the late mid-1970s.

MR. FEATHERSTONE: Dr. Stalling, is there any subject to confidentiality agreements?

THE WITNESS: Not so far as we have. We do not enter into an agreement unless we are forced

Theo L. Urban  
Certified Shorthand Reporter  
174 South L. Salle Street  
Chicago, Illinois 60601

Stalling - direct (Pope)

to do so.

MR. FEATHERSTONE: Answer Mr. Pope's question.

BY THE WITNESS:

A What was it? This was with the Industrial Chemical Division in Monsanto, and again I do not recall the person's name that was the project coordinator on the evaluation of various phthalate esters. They are plasticizers. Again, comparative toxicity and the environmental fate was the focus of that. In the vitae you will find the results of some of that work. That has been a long time ago, in relationship to current research.

Q Is that the only other project that you are aware of that your lab worked with Monsanto in?

A I am sure there were other chemicals that would relate to the Agricultural-Chemical Division. Roundup, for instance. We did an analytical project with Monsanto, St. Louis on the determination of Roundup, in which one of our chemists, Jim Johnson, spent some time in their laboratory on methodology development, and there were biological tests done on industrial -- I mean agricultural chemicals, which

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street



## Stalling - direct (Pope)

I couldn't begin to recall.

Q Any others come to mind?

A I just can't answer at the moment. I know there are numerous pesticides that have been tested for not efficacy, but for toxicity.

Q Is your laboratory privately owned?

A No. It's the Department of Interior, U.S. Fish and Wildlife Service.

Q Would it be fair to say that work done for private industry or studies for private industry would be the exception to the work done by your laboratory?

A No.

Q No?

A By exception if --

Q As opposed to doing work for the United States Government or its agencies.

A Can I clarify the answer the best I can?

Q Sure.

A I will try to answer your question.

Q Yes.

A In cases of environmental impact for aquatic resources, we are interested in terms of,

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street

## Stalling - direct (Pope)

as far as I understand Fish and Wildlife Service policy, and I am not making a policy statement, it is in the interest to minimize or gather information which would minimize the impact on aquatic resources through use of chemicals where better acceptable alternatives exist. Some of this involve operational policy of what fish disease do you kill with what drug. Or weed control problems that might exist on operations on public lands, et cetera.

So it is in the Government's interest to minimize the impact of chemical usage, as I perceive our objective. Consequently, that requires in some cases cooperation with willing industrial people. We do not have all chemical resources available to us. So usually these are done where it's in the interest of the Government and in the interest of the public domain to generate some information to set up alternatives in the use of chemicals. We have had very good operation and liaison with numerous chemical companies, including Monsanto.

Q My question was just how often does that happen as opposed to doing work for the Government?

A I can't quantitate that. It could be

Ther L Urban  
Certified Shorthand Reporter  
and C. L. R. S. C. S. S.

Stalling - direct (Pope)

quantitated, it is not a minor operation. It is not the exception.

Q You made reference earlier this morning or earlier this afternoon to a study you had underway in the bioaccumulation of dibenzofurans, I believe.

A Yes.

Q Can you tell me what that study is designed to show, and under what auspices that is being done?

A That is a cooperative project with Dr. Rappe in Sweden, the National Center for Toxicology Research through personal cooperative research with Dr. Ron Mitchum, Dr. Mayer of our lab, and myself. The objectives are to compare bioaccumulation and elimination of 2,3,7,8 TCDD, 2,3,7,8 TCDF, and a mixture of dibenzofurans with respect to understanding and interpreting environmental residues, as well as to assess toxicological importance of these residues, interpretive research for assigning significance to these residues.

Q At what stage of the proceedings is that?

A It is in the first stages of implementation.

Q You have collected the data?

A No.

Theo L. Urban  
Certified shorthand Reporter  
134 South Lehigh Street  
Allentown, Pa.

## Stalling - direct (Pope)

Q Has there been a draft report?

A No.

Q You have collected the analysis?

A No. We are preparing the test aquaria to do the research.

Q That is as far as it has gone?

A That is correct.

Q Doctor, did I correctly understand your testimony this morning to be that it is your opinion that PCBs in the sediment continue to transport to the water regardless of how deep they are?

A Yes.

Q Would it be fair to say that the only aspect of sediment that plays any kind of a serious role in transport of PCBs would be the top ten centimeters or so?

A I disagree with that.

Q Why do you disagree with that?

A Because we have invertebrates and various organisms which permeate the sediments, and there is considerably greater exchange than the top little portion of sediment.

Q What are you basing that opinion on?

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Pope)

A On published information pertaining to the composition of sediments and worm burrow holes in estuaries and other lake sediment, bottom boring invertebrates.

Q Where is that published?

A I cannot recall the specific information other than -- I can't give you these. I just don't recall.

Q Is it your understanding that that literature supports the notion that these substances are basically invertebrates?

A That and worms and the like, you know.

Q Are present at all layers of the sediment below the surface?

A They are not present at all layers, but I am not -- There is a word for the right discipline that deals with the invertebrate organisms, and I am only stating what I have read in published literature pertaining to permeation of water into sediments through burrowing insects, they are insects. That is one facet of trying to answer your question.

Q Is this an area that you consider yourself an expert in?

Ther L Urban  
Certified Shorthand Reporter  
114 South La Salle Street  
Chicago, Ill. 60603

## Stalling - direct (Pope)

A I do not.

Q Do I understand that one of the techniques that you or your laboratory has perfected in this area relates to gel permeation?

A Yes, permeation chromatography.

Q Can you describe for us and tell me why that is an improvement over the past technology?

A Yes. In doing any kind of trace analysis from fish and to sediments as well, you extract a relatively large amount of lipid related material. In some cases biogenic, and in some cases not biogenic. Oil from petroleum application spills. This material from a solubility viewpoint is quite similar to PCBs and other environmental contaminants. In doing an analysis at trace levels it is imperative that you go through what is called and we have defined it in the literature as enrichment. We must reject a large amount of the matrix in order to get the samples concentrated in a form that will not interfere or degrade the columns or instrumentation that are used in making the measurements.

A procedure and idea which I had conceived and implemented and constructed equipment to do that

Thos L Urban  
Certified Shorthand Reporter  
114 South Main, Suite 200

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with embodies gel permeation chromatography, which by simple analogy, gel permeation chromatography, you take a sieve with two inch holes and two inch marbles and a beach ball, and to separate these large molecular weight coextractives, such as fat, triglycerides, you put two inch marbles and beach balls on the screen, and the beach balls will roll across the table and not interact with the holes, and the small spears will fall into the holes and consequently not roll across without some effort.

Therein lies the principles for the separation on the basis of molecular size by analogy. We have shown and developed systems in which more than 99, 98 percent of the lipid and coextractive materials of larger molecular weight are removed from the smaller more compact contaminants or PCBs, or what have you.

This enrichment process is very important in subsequent analytical separation. There are other alternatives, but composition changes can be induced by partitioning steps, and consequently we mechanize this procedure, and this is employed in approximately 500 laboratories. I hold the patents for both the

Thea L. Urban  
Certified Shorthand Reporter  
200 South La Salle Street  
Chicago, Illinois 60604

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instrumentation -- public patents for the instrumentation and the process. They are public patents, in the public domain.

Q Can you give any estimate of the extent to which this has improved the accuracy of the figures you are able to reach with this method?

A Well, in some cases it is not possible to do the analysis without those techniques. I could cite other contamination. For PCBs it is an important fact, but it does not preclude generating PCB residue information by other techniques. It is a marked improvement in the efficiency with which samples are handled and the precision that one can obtain by keeping all of the compounds together.

I can tell you for instance in specific terms that we can account for about 97 percent of the variance in the sample sets. That we have only approximately 3 percent alteration in the composition from this whole analytical scheme.

Q How would you compare that to techniques before that was developed?

A Probably 50 percent would have an extremely good result, 50 - 60 percent, to be able to keep

Ther L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603



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together that much of the sampling information.

Q When did you develop this technique?

A In 1968-69.

Q Was it available, was it marketed beginning then?

A Not until 1970, I don't know, 1971, 1972, 1973. We built three instruments for Government laboratories before we determined to implement the technique and to get it into practice.

Q Is it used in conjunction with the study in using the gas chromatograph and mass spectrometer?

A Yes.

Q Is it a prior step, in effect?

A Yes.

Q Is there to your knowledge an accepted standard deviation in results that are used today with the gas chromatograph and mass spectrometer for PCBs?

A There is a standard -- Yes, there is a standard proposed in the document cited in the material that is attached in the publications from the PCBs -- I can't tell you.

MR. WHITE: You want to look at the document?

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Certified Shorthand Reporter  
124 South La Salle Street

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BY THE WITNESS:

A I need to look at the references. It is a publication citation there. I can give it to you. I just can't recall.

MR. WHITE: That is the one with the CV?

MR. POPE: Yes.

BY THE WITNESS:

A It is not mine, but in the references -- You are in the wrong place.

BY MR. POPE:

Q Can you tell me something about what I am looking for?

A The documents used in support and formation of my opinions, the references.

Incidentally Derived PCBs. There is a current regulation regulatory move on the part of the Environmental Protection Agency to regulate -- I don't know -- incidentally derived PCBs. That is PCBs made in industrial manufacturing process, and the quantitation and methodology is discussed in great detail and very complimentary to this data set in that document. I believe I am correct that errors on the order of 10 percent would be desired. But

Ther L Urban  
Certified Shorthand Reporter  
174 South 11th Street  
Chicago, Illinois 60603

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that is --

Q That is today?

A That is today, yes.

Q How about in 1971, what would be your estimate of the standard deviation then?

A Thirty percent.

It is important to point out to you that that number is not a single number, but that it depends on concentration. Dr. Horwitz from the Food and Drug Administration several years ago published information pertaining to the standard deviation as a function of concentration, and showed that as one decreases in concentration towards parts per trillion that the errors increase. So that process is well defined in the literature in terms of concentration dependency on measurements.

Q When did you first become aware of the presence of PCBs in the environment?

A About 1968, a few months after I joined the laboratory.

Q Can you tell me what the occasion was for you to become aware?

A We had purchased a mass spectrometer and

Thea L. Urban  
Certified shorthand Reporter  
174 South La Salle Street

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installed it, and I had some correspondence or literature. I had read the literature publication by Dr. Jensen reporting PCBs, and we had information on pesticide residues that we could not reconcile as being pesticides. Subsequent investigation proved these materials to be PCBs.

Q Subsequent investigation in the use of the mass spectrometer?

A Yes, in our laboratory.

Q In your analysis, right?

A Yes. The results were published in the AOAC. I don't know. It is on that list. 1971, 1972, 1973, somewhere in there.

Q That is on your list of publications?

A That is correct.

Q That was the first time you published anything indicating your findings with regard to PCBs?

A To my best recollection, right. About 1972 or somewhere in there, I just don't recall the date. In 1971 we did the report.

Q Indicating for the record I have handed you your list of publications to refresh your recollection.

A There was a subject of PCBs in gel permeation

Theo L. Urban  
Certified Shorthand Reporter  
114 South La Salle Street

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and chromatography in this Helsinki presentation.

Q In 1971?

A In 1971. I was off earlier in the date when I talked with Dr. Rappe. Because this would have been the time I met him first.

Q Your earlier testimony regarding when you decided to begin studying for the presence of dibenzofurans in the environment was 1971?

A Yes.

Q Through 1974?

A That is correct.

Q Was there anything in the literature with respect to dibenzofurans?

A Yes, there was.

Q As of that period of time?

A Yes.

Q What was that?

A That was a search -- I believe approximately at that time or shortly after a publication appeared in which they searched for PCBs in biota and found none. That was published -- Risebrough was not the principal author.

Q This is people at Southern Cal?

Ther L Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

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A Yes, I think that is.

Q Someplace on the West Coast?

A On the West Coast. Dr. Risebrough. It was one of the publications. He and another investigator whose name I do not recall. Yes, this publication, number 2, Journal Association of Fish Analytical Chemistry, Volume 54, Page 801-807, 1971.

MR. POPE: Let's mark this as Stalling Deposition Exhibit No.4 for identification, being a list of publications.

(Said document was marked Stalling Deposition Exhibit No.4 (OMC), for identification, as of 9/9/82, JKS.)

BY MR. POPE:

Q Just for the record, Dr. Stalling, we have identified as Exhibit 4 the document you have just been referring to, the publication list, is that correct?

A Yes.

Q Is this a complete and accurate list of all the articles you published in scientific areas?

A Insofar as I am aware of. It does not

Thos L Urban  
Certified Shorthand Reporter  
C. L. Urban

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include all the publications since or possibly during 1979. That material is subject to correspondence.

Q That material is what?

A That material, there is additional information that you had been provided on more recent publications than 1979.

Q Is that what this is?

A Yes.

Q Does this take us up to the current date, these four pages?

A Yes, including manuscripts, some of which are in preparation.

MR. POPE: Miss Reporter, would you mark this as Stalling Deposition Exhibit No. 5 for identification, the four additional sheets.

(Said document was marked Stalling Deposition Exhibit No. 5, (OMC), for identification, as of 9/9/82, JKS.)

BY MR. POPE:

Q Dr. Stalling, this Exhibit No. 5 for identification are some materials that were provided to us. Would you summarize what those are for us.

A Those are a list of publications and

Ther L Urban  
Certified Shorthand Reporter  
174 South 1st, Suite 200  
St. Louis, MO 63102

## Stalling - direct (Pope)

materials in publication from laboratory studies that I am involved with.

Q That brings us up to date on your publications, is that right?

A I am 99 percent certain you have them. There may be some publications that are not present there, but I am not aware of other publications we have omitted.

Q Can you summarize for us briefly your educational and work experience up to date?

A Not very briefly.

Q Well, do your best. Take your time.

A Okay.

MR. WHITE: Mike, I am going to object to that. That was the first question out of the box this morning.

MR. POPE: I was under the impression it was not asked. I am sorry. Was it?

MR. WHITE: He asked what he did prior, how long he worked for the lab, what he did prior to that, and what he did prior to that. He went back to when he was working on a construction job with his father.

MR. FEATHERSTONE: Let's go off the record.

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Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois



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MR. POPE: I will accept your representation. I apologize for inquiring into something that was covered before.

MR. FEATHERSTONE: No, no, no.

Could we go off the record for a second.

(Discussion had off the record.)

BY MR. POPE:

Q Dr. Stalling, what is the rate at which you are being paid for work on this case?

MR. WHITE: That has been asked and answered, too.

THE WITNESS: Do you want me to --

MR. WHITE: Go ahead and answer it.

BY THE WITNESS:

A The total compensation the laboratory will receive, of which I do not receive any direct compensation, other than my normal salary, is not to exceed a total of \$6,000, under the present agreement, and for the laboratory phase of the work, \$4,000, the direct salary cost.

Q The balance of the two?

A The travel and incidental expense, report preparation, et cetera.

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Certified Shorthand Reporter  
174 South La Salle Street

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Q I would like to call your attention, Doctor, to Table 4 of your Exhibit No. 2, please. There is a comparison of 1242, 1248, 1254 and 1260.

A Table 4?

Q Yes, sir. Each of those samples, Doctor, can you tell us whether that is a mixture of various Aroclors?

A Clarify the question. Table 4?

Q Yes. Calling your attention to the concentration in sample columns.

A Okay.

Q S421, S422, et cetera.

A Yes.

Q Are those, each of those samples, a mixture of various -- or are they, to your understanding, solely 1242?

A No.

Q 1242 or 1248?

A These data are generated from the matrix sum and simply illustrate by total chlorine number what the fractional composition of the various degrees of chlorination are. My best analysis of this information, I would indicate that these would be a

Thea L. Urban  
Certified Shorthand Reporter  
124 South La Salle Street

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mixture of Aroclor 1242 and 1248, possibly with some components missing.

Q Am I correct in assuming that this chart tells me under column S423 that 25.6 percent of that sample was comprised of 2 chlorene PCBs?

A That is correct.

Q And that the Aroclors themselves don't have that high a percentage, i.e. 14.1?

A Yes, 1242.

Q How do you explain that?

A By having enhanced concentration of the specific components in the 1242, would be the first explanation.

Q How do you get an enhanced concentration?

A Certain components were still present at elevated concentrations. There had been some disproportionation in that sample. That is all you can conclude. If you are interested in the specific components, that information would be contained in the report, Appendix C, probably.

Q C?

A Yes.

For the record, can I clarify this for you?

Q Yes.

Thos L Urban  
Certified Shorthand Reporter  
134 South 1st St  
St. Paul, Minn

Stalling - direct (Pope)

A These data are pulled from Appendix C, in an attempt to -- just a summary of information.

Q Does this data tell you anything about degradation of these samples?

A Yes.

Q What does it tell you?

A It tells me that not all components degrade at equal rates. That would be the most logical conclusion I would draw.

Q Between 1242 and 1248 which degrade at a greater rate?

A We would have to go into the individual isomers and components to get at this specific answer to that question, and I have not dealt that long with these data to be able to answer your question more explicitly, but certain dichloro components were very high in that respect, in that sample.

Q Is that result surprising to you?

A No. I indicated earlier in my testimony that there were differences in rates of degradation based on partition coefficients and positions of whether they were or were not adjacent to carbons and so forth, and the partition coefficients certainly

Stalling - direct (Pope)

influence some of that. But since they are dichloro, I can tell you the results, and I can't explain them any further.

Q Is there any reason why when you did your study on Exhibit No. 1 you didn't measure for PCB content?

A Yes. At that time we were only doing a very limited number of total PCB composition, and the main focus was on trying to generate information pertaining to the orthochlorene and dibenzofurans and dioxins.

Q At the time you did that study you weren't attempting to relate those elements to PCBs?

A No. We had already completed the 25 or so samples, and were not able to do all the analyses for all samples.

MR. POPE: Subject to Mr. Featherstone's motion and Ms. Stein's return, I have nothing further at this time.

MR. WHITE: Do you have any further questions, Bruce, tonight?

MR. FEATHERSTONE: I have to talk to him.

(Discussion had off the record.)  
(The deposition was recessed to September 10, 1982, at 10:00 o'clock a.m.)

Thed L Urban  
Certified Shorthand Reporter  
124 South 1st Street, Suite 100  
New Orleans, LA 70112

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IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF ILLINOIS  
EASTERN DIVISION

THE UNITED STATES OF AMERICA,	)	
	)	
Plaintiff,	)	
	)	
vs.	)	No. 78 C 1004
	)	
OUTBOARD MARINE CORPORATION and	)	
MONSANTO COMPANY,	)	
	)	
Defendants.	)	

The deposition of DR. DAVID STALLING resumed pursuant to adjournment, on September 10, 1982, 219 South Dearborn Street, Chicago, Illinois, at the hour of 10:00 o'clock a.m.

PRESENT:

MR. JERROLD H. FRUMM,

MR. JAMES WHITE,

Appeared on behalf of the United States  
of America;

MR. MICHAEL A. POPE and

MR. JEFFREY C. FORT,

Appeared on behalf of Outboard Marine  
Corporation;

MR. BRUCE A. FEATHERSTONE,

Appeared on behalf of Monsanto Corporation.

ALSO PRESENT:

MR. MARK SCHNEIDER,  
MR. FRED D. HILEMAN.

Theo L. Urban  
Certified Shorthand Reporter  
139 South La Salle Street  
Chicago, Illinois 60603

DR. DAVID STALLING,

called as a witness by the Defendant Monsanto Corporation for examination, having been previously duly sworn, was examined and testified further as follows:

DIRECT EXAMINATION

BY MR. FEATHERSTONE:

Q Dr. Stalling, you understand you are still under oath from yesterday.

A Yes, sir.

Q It is your opinion that the non-ortho PCBs are of concern?

A Yes, they are.

Q Are there any PCB isomers other than the non-ortho PCBs that are of particular concern to you?

A Yes, sir.

Q What are those?

A Those would be the group of isomers having at least -- having one chlorene in the ortho position.

Q How many isomers with that characteristic are there?

A There are approximately 13 isomers in that group of concern, having 2,4 substitution. I refer to the work of -- Okay. 13 isomers of particular concern in the one orthochlorene substituted group.

Theo L. Urban  
Certified Shorthand Reporter  
174 South 1st, Suite 200  
Chgo, Ill. 60601

## Stalling - direct (Featherstone)

Q Do you call those one ortho substituted PCBs?

A Yes, sir.

Q Of those one ortho substituted PCBs are there a subset, or several of them, that are of more concern than others, as far as you are concerned?

A Yes, sir.

Q Which are those?

A Those having at least 3,4,3 prime -- Wait a minute. Isomers having at least the substitution pattern of one orthochlorene and a 3,4 and at least a 4 prime. Okay. So the lowest level of concern would be 2,3,4,4 prime, and isomers with additional chlorene substituted in either the 3,4 or 3,4,5 positions.

Q Got it.

A Okay.

Q How many isomers of PCBs fall in this special category of one ortho PCBs?

A I think approximately ten, approximately ten, ten or eleven of the 13, and I would have to go by memory.

Q In the work that you did on the fish samples

Thea L Urban  
Certified shorthand Reporter  
114 South 1st, Gulf Breeze



Stalling - direct (Featherstone)

from Wakegan Harbor did you find all 13 of those one ortho substituted PCBs?

A We found a number of them, and I would say by a number I can't recall at this point how many of the 13 are present.

Q Were there some that you did not find?

A Yes, I am sure there were.

Q Are all of the 13 one ortho substituted PCBs found in Aroclor 1242?

A Without -- No.

Q Are all of the 13 one ortho PCBs found in Aroclor 1248?

A I am not able to answer that question at the moment.

Q Have you done that analytical work to determine that in the past?

A We have reported what we found in the Aroclors, and it would require a detailed analysis of that report to answer your question specifically. I have not that information and recollection at the moment.

Q Dr. Stalling, is it your best judgment that these one ortho PCBs have been present in fish in

Thea L. Urban  
Certified Shorthand Reporter  
156 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

Lake Michigan since approximately the time PCBs first found their way into Lake Michigan?

A Yes.

Q Is it your best judgment that plant workers who work with Aroclor products in like a dielectrical industry, those plant workers were exposed to one ortho PCBs as well?

A Yes.

Q Can you think of any of these one ortho PCBs, I think you said there were 13, that have not been in Lake Michigan fish basically the entire time that PCBs have been in Lake Michigan?

A At this point I couldn't answer that question.

Q Would that be your answer if I asked you whether there were any of these one ortho PCBs to which the plant workers hadn't been exposed?

A Yes.

Q Have you been able to perform any calculations to estimate the mass of one ortho PCBs in the sediments of Waukegan Harbor?

A Yes.

Q Have you done that?

A Yes.

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Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

Q Now, make sure I understand. You have done it for only those five sediment samples.

A That is correct, and that was the inference of my answer.

Q My question is a little broader than that. Can you calculate or have you calculated, first of all, the mass of one ortho PCBs, the quantity of them in all of the sediments of Waukegan Harbor?

A No, I have not.

Q Are you able to do that?

A It is possible to do that.

Q Do you presently have the information to do that?

A No, I do not.

Q What information would you need to be able to do that?

A One would need the concentration and mass -- concentration of PCBs and the quantity of sediments with an estimated concentration of PCBs.

Q With that information you can make that calculation?

A That is correct.

Q Are there one ortho PCBs in the water column

Ther L Urban  
Certified Shorthand Reporter  
134 South La Salle Street

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of Waukegan Harbor?

A I can't answer that, as I have no data.

Q You mean you haven't analyzed any water samples?

A That is correct.

Q Are the levels of one ortho PCB that you found in fish, in the fish samples from Waukegan Harbor, are those levels different than the levels you found elsewhere in Lake Michigan fish?

A They may be. I would have to -- They may be. Okay.

Q I take it from your answer that you have not compared the two?

A That is correct, I have not at this point digested the information.

Q Is it fair to say from your review of your analysis of the fish samples from Waukegan Harbor that when you saw the data for the one ortho PCBs in the fish tissue, that that did not jump out at you as being abnormal?

A I don't think I could comment either way at this point. That they are normal or abnormal. That I haven't done any extensive mental digestion of all

## Stalling - direct (Featherstone)

of the facts at this point.

Q If I told you that we had made that comparison with your own data and found that the levels of one ortho PCB in the Waukegan Harbor fish samples are basically no different than the levels that you found elsewhere in the Great Lakes, would you have any reason to dispute that?

A As I say, I have not done that, and I would prefer not to comment.

Q In your judgment are the physical and chemical characteristics of the one ortho PCBs that are found in fish elsewhere in Lake Michigan the same as the physical and chemical characteristics of the one ortho PCBs that are found in the fish tissue in Waukegan Harbor?

A Yes. Your question says are isomers such as 2,3 substituted the same as isomers if they are -- Based on the chemical identity, they are identical isomers if they are reported as such.

Q Is there any difference at all between the one ortho PCB isomers that you found in the Waukegan Harbor fish samples, and the one ortho PCBs that are found in Lake Michigan fish elsewhere?

A By recollection I would say there is a difference.

Thea L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street

## Stalling - direct (Featherstone)

Q There is a difference?

A Yes.

Q What is that difference?

A The fish from Waukegan Harbor tend to have higher concentrations of the components from 42 and 48, as contrasted to a much larger profile of 1254 in the Lake proper, in fish from the Lake proper.

MR. POPE: Excuse me. Are we talking about, when you refer to fish from Waukegan Harbor, are we talking about the five samples that you examined?

THE WITNESS: That is correct.

MR. POPE: Fish that were caught in Waukegan Harbor?

THE WITNESS: I am sorry?

MR. POPE: Fish apparently caught in Waukegan Harbor, is that correct?

THE WITNESS: That is correct.

MR. POPE: Excuse me.

BY MR. FEATHERSTONE:

Q Can you explain what you meant by your answer. Are there particular one ortho PCBs that are found in 1242 or 1248 which you believe are in higher concentrations, I guess, in the Waukegan Harbor fish

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

that you analyzed than in fish found elsewhere in Lake Michigan?

A By recollection of the data, yes.

Q Which one ortho PCBs are those?

A I would have to refer to the report items in Appendix C or D, I don't remember.

Q Can you do that for me?

A Yes.

MR. FEATHERSTONE: Off the record.

(Discussion had off the record.)

BY THE WITNESS:

A Referring to the identity of the samples in Table 3, 4 -- Let's just deal with your question. Table 3 and Table 5. These samples identity are set out under the designation of the CNFRL, beginning with the F141 through 147.

Q You are referring to Table 5 there?

A I am referring to the sample identification on Page 3 of this report -- or 53605, U.S. 53605. Setting out those samples in 141 through 147, and the sample number 154 such as say from Lake Michigan, Sheboygan, lake trout F145. F145 can be found in Table 2, continued on Page U.S. 53617. Comparing the

Ther L Urban  
Certified Shorthand Reporter  
176 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

composition of any one of the samples you might choose from 141 to 147. With sample 145 you will note in the bracket under the trichloro and tetrachloro PCBs for percent of isomers concentrations having either trichloro, pentachloro, or tetrachloro you will notice those concentrations for trichloro in fish 154 are 1.5 percent, 18.4 percent, and 41.2 percent for tri, tetra and pentachloro. Take any sample you wish, and you will notice the difference in the trichloro percentage. For the sample set 141 through 147 it is approximately 30 times greater, just working from the percentages of the total residues having 3 chlorene.

If you go to the matrix reports as shown, and we won't, unless you wish to go through the details of this, but you can quickly discern what we are talking about when you look at the matrix report here preceding any one of the samples from F141 through 147, that the ortho, ortho prime -- ortho substitution across the top row, and the columns giving you the trichloro breakout. Approximately 20 percent of the residues fall in the one ortho chlorene PCBs. I mean, taking sample F154, which I think --

Q Which page?

Theo L. Urban  
Certified Shorthand Reporter  
114 South La Salle Street  
Chicago, Illinois



Stalling - direct (Featherstone)

A That is U.S. 53794.

Q What appendix are you in?

A Just a minute. I think it is C.

Q Wait a minute.

MR. POPE: The page numbers do not help us much, because we don't have --

BY THE WITNESS:

A I regret no page numbers are in those appendices. But the samples are identified by lab code F154. You can do this for any one of those sets as you choose. You will note that the percentages of trichloro in the Great Lakes went at one ortho chlorene, or approximately 1.5 percent. For tetrachloro, ten percent.

Going to Appendix B. Just pick sample 145, you will notice it is a --

BY MR. FEATHERSTONE:

Q What page are you on?

A 53727. Fish sample F --

Q Wait a minute.

A Pick any one you like. It may not be a good, the best example.

Okay. All I wanted to point out is that

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Ill. 60603

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that question can be answered by comparing the percentage compositions of chlorene having one ortho chlorene from Waukegan samples. First the samples in the Lake, any of the Lake proper, we are working just with the matrix summary as opposed to the individual isomers, because when you get into the individual isomers you will spend a lot of time just getting where these sums come from. It's there in all these reports generated from the following page of individual isomer concentrations, wherein you will also find the total number of chlorenes, along with the appropriate ortho designation for each component set out.

Q Does all this mean that you found in the seven fish samples that you analyzed levels of certain one ortho PCBs to be higher in the Waukegan Harbor fish samples than you find in fish elsewhere in Lake Michigan?

A That is correct.

Q Dr. Stalling, do you have any estimate of the level of any one ortho PCB in the water column of Waukegan Harbor?

A I have not made that calculation or attempted to do that, no.

Q Can you do it?

Therese L. Urban  
Certified Shorthand Reporter  
124 S. W. La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

answer your question.

Q Can you take a look at the data and tell me whether the levels are different?

A Yes.

Q How long will that take?

A To do it, it might take 15, 20 minutes, 15 minutes. The information is present in the appendices, if you want to look at the concentrations. It is reported and documented here.

Q Dr. Stalling, do you have any evidence that the PCBs in the sediments of Waukegan Harbor may become sometime in the future dibenzofurans?

A No, I do not.

MR. WHITE: Wait a minute.

BY THE WITNESS:

A No, I do not. I mean, your question states --  
Restate the question.

MR. FEATHERSTONE: Read the question, please.

(Record read.)

BY THE WITNESS:

A No, with one exception.

BY MR. FEATHERSTONE:

Q What is the exception?

Thea L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

A No.

Q Do you know anyone who has written anything supported by any scientific research that the cooking of fish that have PCBs in them would produce dibenzofurans?

A I would have to answer your question yes by analogy. And the analogy would be in the pyrolysis of chlorophenol to form dioxins, and it has apparently been shown to occur on charcoal broiling of steaks or meat. I recall something in the literature from the conversion of chlorophenol reduced to dioxins. And it would be a chemical certainty or high probability that if you barbecue a Coho salmon on a charcoal grill or charcoal, you likely would produce dibenzofurans. But that is by analogy to known chemical reaction.

Q I take it an experiment could be carried out to determine whether char-broiling a piece of fish would produce dibenzofurans, is that right?

A Yes, that is correct.

Q No such work has been done?

A I have not seen it in the literature.

Q I take it that you have no evidence that would allow you to even by analogy determine to what

Ther L Urban  
Certified Shorthand Reporter  
179 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

extent that transformation would take place, from PCBs to dibenzofurans?

A I can tell you the maximum level I would expect.

Q Well, the maximum level. But can you tell me with a reasonable degree of certainty what would in fact happen?

A Yes. I can give you a range from zero to about one percent of the PCBs.

Q One percent of the PCBs at maximum?

A Could be converted to dibenzofurans. That is based on literature, conversion rates of PCBs to dibenzofurans.

Q Dr. Stalling, is it of concern to you that people cooking fish might by some remote process produce these dibenzofurans?

A I'd say it's a reasonable concern.

Q Have you ever written anything about this in the literature?

A No, I haven't.

Q Have you ever issued any written warning about that?

A Not addressed to that particular question.

Thea L. Urban  
Certified Shorthand Reporter  
130 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

It is the first time I have been asked that question.

Q Is this the first time you ever thought of it?

A Well, frankly, yes, it is, since you asked me.

Q Has there been toxicological research done on the PCB 2,3,4,3,4?

A Yes, there has.

Q Is that documented in literature someplace?

A Yes. I believe you will find it in the literature.

Q Is that an article by you?

A No, sir.

Q By whom?

A Dr. Steven Safe is a co-author of a review in a number of publications of which at the moment I can't recall the specific journals, but the subject had been reviewed, yes.

Q Do you recall what year?

A I would say 1981 or 1982, recent publications.

Q Is Dr. Safe the leading toxicological researcher into the specific isomers, PCBs?

A Among those, yes.

Theo L. Urban  
Certified Shorthand Reporter  
154 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

Q You go to symposiums pretty often, don't you?

A Yes, I do.

Q Have you heard Dr. Safe state, or have you seen it stated by him in writing, that because research can be done into specific isomers of PCBs it's not really necessary to analogize to similar isomers that are dibenzofurans or dioxins? Have you ever heard him say that, or write that?

A I think I have heard him say the converse.

Q It would surprise you then if in some proceedings of a symposium that you attended that the transcript shows that he made that statement?

A Again, you asked me by memory or do I remember, and I would have to say on the basis of memory I would be under the impression that it -- I am, from recall stating I believe he said that dibenzofurans -- that PCB isomer research on the effects of PCBs would serve as a good model for evaluating specific dibenzofurans and dioxin isomers. And he further drew analogies to structure relationships between PCBs with various types of substitutions, and the most toxic dibenzofurans and dioxin isomers.

Q I may have asked you this yesterday, and

Thea L. Urban  
Certified Shorthand Reporter  
24 South La Salle Street

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if I did, I apologize. I racked my brain last night to recall, and I came up empty.

Have you ever analyzed any Pydraul fluid for dibenzofurans?

A To my recollection, I do not recall having analyzed pydraul fluids for PCBF, but we did do some cooperative work with Dr. Rappe, and there may have been a sample of that present, but I can't possibly remember that.

Q Did you ever analyze any pydraul fluids for concentrations of non-ortho PCBs?

A Not to my knowledge. Not to my recollection.

Q Did you ever analyze any Pydraul fluids for one ortho PCBs concentration?

A The same answer, I can't recall having done it.

Q Dr. Stalling, if the concentrations of one ortho PCBs in the sediment samples and fish samples that you analyzed from Waukegan Harbor were lower than the levels for those same one ortho PCBs in the original Aroclors, would that be significant to you?

A Yes.

Q Would that tell you that the one ortho PCBs

Thea L. Urban  
Certified Shorthand Reporter  
114 South La Salle Street  
Chicago, Illinois 60603  
712-180-5550



## Stalling - direct (Featherstone)

are disappearing relatively more rapidly than other PCBs?

A Time out for just a minute. Are we dealing with sediments -- The original question dealt with sediments. I want to make sure.

Q Sediments and fish.

A Okay. Sediments and fish. And this last question -- Read that for me again.

MR. FEATHERSTONE: Would you read it back, please.

(Record read.)

BY THE WITNESS:

A It could. Depending on the species that we are dealing with. Two scenarios could exist. One being --

BY MR. FEATHERSTONE:

Q What is the first scenario?

A The first scenario is that microbial degradation is occurring, could occur.

Q That is microbial degradation in the sediments?

A In the sediments. Or that organisms degradation could occur in fish.

Q Which is metabolism.

Theo L Urban  
Certified Shorthand Reporter  
W. H. S. C. Co.

## Stalling - direct (Featherstone)

Q Well, do you have evidence that in some species of fish there is in fact degradation of one ortho PCBs?

A I have as yet not formulated an opinion on that question.

Q No. The question is whether you have evidence that there are some species of fish that degrade one ortho PCBs more rapidly than other PCBs?

A If they do, yes -- Yes. And if we do have the information it's present in this report.

Q Now, do you have any evidence that shows that there are certain fish that do not degrade one ortho PCBs more rapidly than other PCBs?

A I am uncertain whether I have that information or not. If we have the information, it's here or it's in the New York Academy of Science publication.

Q Well, when you say here, you are pointing to Exhibit 2, is that correct?

A That is correct.

Q If the data in Exhibit 2 showed that for each of the fish samples that you analyzed, for each of those samples the level of one ortho PCBs is less than the level of one ortho PCBs in the original

Ther L Urban  
Certified Shorthand Reporter  
119 South La Salle Street  
Chicago, Illinois 60601

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Q What is the other explanation if they are not degrading in the sediments or being metabolized by the fish?

A You have not adequately defined in your question the composition of the PCBs to which you make a comparison, because you are dealing with additive compositions, and making a comparison to one of two possible Aroclors and combinations of mixtures, combinations thereof.

Q But this is something that you haven't studied yet, is that correct?

A That is correct.

Q Now, if the levels of one ortho PCBs in the sediments are less than -- speaking now only of sediments, are less than the levels of one ortho PCBs in the original Aroclor 1248, is that consistent with an explanation that those one ortho PCBs are degrading more rapidly in the sediments than other PCBs?

A Yes, but only if that is the only Aroclor input that exists.

Q If the one ortho PCB levels in the fish samples from Waukegan Harbor are less than the one ortho PCB levels in the original Aroclor 1248, if

Theo L Urban  
Certified Shorthand Reporter  
174 South La Salle Street

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Aroclor 1248, that could not be evidence, could it, that the fish were unable to degrade one ortho PCBs?

A I would take issue with the "could not" statement.

Q Is it your best opinion, based on that assumption, that those fish are in fact degrading one ortho PCBs?

A Not necessarily. As I indicated earlier, due to partition coefficient differences, it is one alternate explanation. You are asking me for yes or no answers, and I don't feel qualified at this point to give you one.

Q If the level of one ortho PCBs in the sediment samples and in the fish samples that you analyzed are less than the levels for the one ortho PCBs in the original Aroclor 1248, does that suggest that there is both degradation of those one ortho PCBs in the sediments and metabolism in the fish?

A Not necessarily.

Q Is it consistent with that explanation?

A That is one possible explanation.

Q Have you ruled out that that is happening?

A No, and I haven't established it, either.

Theo L. Urban  
Certified Shorthand Reporter  
124 South La Salle Street

## Stalling - direct (Featherstone)

that were true, is that consistent with the explanation that the fish are metabolizing one ortho PCBs more rapidly than other PCBs?

A Not solely.

Q But is it consistent with that explanation?

A Not entirely.

Q Have you ruled out that that is happening?

A No, nor have I established it is happening.

Q Have you determined that certain isomers of PCBs are picked up more rapidly than others by the fish?

A I think at this juncture I have to say no to your question.

Q In other words, you cannot tell that from the data in Exhibit 2, for instance?

A That is correct.

Q Have you determined from your research or research that you have reviewed that certain PCBs tend to go to the sediments rather than to fish?

A I'd have to say yes, but only to a very limited extent.

Q You mean you only made that determination to a very limited extent?

Ther L Urban  
Certified shorthand Reporter  
104 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

A That is correct. I don't mean that only that it occurred to a limited extent. I am simply stating that I have -- I am answering yes to your question in terms of literature and that, but I do not have a large amount of data. Okay?

Q To the limited extent that you have made any determination, what is that determination?

A Well, it could be that the Cl 4, and Cl 5 and Cl 6 isomers are -- Now are we talking about fish or sediments?

Q Sediments.

A All right. I have to keep the samples straight. In sediments the Cl 6, 7, and 8, Cl 6, 7 and 8 isomers could be enhanced.

Q In other words they would tend to go to the sediments rather than to fish?

A Well, no, I am not saying that. I am saying in a relative composition those isomers could be enhanced.

Q Is that because they are less soluble than the lower chlorinated isomers?

A Yes, that is one possibility.

Q Is that in your judgment the most likely explanation?

Thea L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

A Solubility combined with Log B. Solubility combined with partition coefficient.

Q Log B?

A I said that, Log B. That is a chemical term.

(Discussion had off the record.)

BY MR. FEATHERSTONE:

Q Have you made any determination regarding the equilibrium and distribution of PCBs in Waukegan Harbor?

A Well, yes, insofar as data for sediment and fish are presented.

Q You are referring now to Exhibit 2?

A Yes, yes.

Q Now, what does Exhibit 2 tell you about the equilibrium and distribution of PCBs in Waukegan Harbor?

A Based on the data one should compare the composition and fractional composition between fish and sediments to answer your question, which I have not done in detail.

Q You are not prepared to answer that at this time?

A Today, I am not.

Theo L. Urban  
Certified Shorthand Reporter  
24 South La Salle Street  
Chicago, Illinois 60603  
312-467-1111

## Stalling - direct (Featherstone)

Q What determination have you made regarding the equilibrium and distribution of PCBs in Lake Michigan, or are you likewise not prepared to answer that at this time?

A Well, I would say in terms of residue composition in Lake Michigan fish we have presented that information as well.

Q Does that talk about equilibrium and distribution of PCBs in Lake Michigan fish?

A If this was one example. I would say that the information cited in the literature you were supplied touches on other aspects of that question.

Q Well, okay. Now, you are referring to Exhibit 2, is that right?

A Yes. I was referring to Exhibit 2.

Q Exhibit 2 contains the information that you have that bears on the issue of the equilibrium and distribution of PCBs in Lake Michigan?

A Not solely, not entirely.

Q Well, is most of it in Exhibit 2?

A No.

Q Have you made any determinations concerning the equilibrium of PCBs in Lake Michigan?

Ther L Urban  
Certified Shorthand Reporter  
1705 N. 1st St., S.W.



## Stalling - direct (Featherstone)

A In terms of residue composition in --

Q In fish?

A In fish, yes.

Q Only to that extent?

A That is correct.

Q When you say residue composition, you mean what types of PCBs are in those fish in Lake Michigan?

A Yes.

Q And at what concentrations?

A That is correct.

Q Now, when you talk about the distribution of PCBs in Lake Michigan, have you made any determination about that?

A We need to clarify the question in terms of distribution of composition versus distribution of fish in the Lake. We addressed distribution of the PCBs in fish samples a moment ago. Distribution of PCBs in the fish is known in the various locations of the Lake.

Q That simply refers to what type of PCB is found in what species of fish, in what portion of the Lake?

A Yes.

Thos L Urban  
Certified shorthand Reporter  
115 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

Q And that data is in Exhibit 2.

A Not solely.

Q Some of that data is in Exhibit 2?

A Yes.

Q Now, I may have asked you this just a moment ago, but maybe I am getting confused. Is there any difference between equilibrium and distribution of PCBs in Lake Michigan as far as you are concerned?

A Yes.

Q They are one and the same?

A No.

Q There is a difference?

A Yes.

Q Have you made any determination about the equilibrium of PCBs in Lake Michigan?

A Yes.

Q What determination have you made?

A Based on the literature assessments.

Q Not on your own research?

A Not on my own research, no.

Q Based on the literature assessment, what do you have to say about the equilibrium of PCBs in

Thea L. Urban  
Certified Shorthand Reporter  
174 South La Salle Street

## Stalling - direct (Featherstone)

Lake Michigan, data supported by what you consider to be sound scientific research?

A I think that issue is far from completely resolved, as to steady state concentrations.

Q Is that all you have to say on that?

A Yes.

Q You say it is far from resolved?

A Yes.

Q And that means there is still significant uncertainty in your mind?

A That is correct.

Q Can you summarize what the data shows about the distribution of PCBs in Lake Michigan?

A Very simply that there is a difference between north and south.

Q Does that mean that the levels of PCBs in the fish in the southern part of Lake Michigan are higher than they are in the northern part?

A By recollection I think that is correct.

Q Do you have anything else to say about the distribution of PCBs in Lake Michigan?

A That is a pretty open question. Probably.

Q Probably?

A Yes.

Thos L Urban  
Certified Shorthand Reporter  
1000 1/2 N. 1st St. S.

## Stalling - direct (Featherstone)

Q Can you think of anything else that you want to say that is supported by sound scientific research at this time about the distribution of PCBs in Lake Michigan? Would you like to take a pass?

A I will pass on that.

Q Okay. The composition of PCB residues in the Great Lakes, I take it whatever you have to say about that is based on the research that you have done into what types of PCBs are in these fish?

A That is correct.

Q Is that all that means, composition of PCBs in the fish in the Great Lakes?

A I would ask you to clarify your question.

Q Sure, I am sorry. Any testimony discussing the composition of PCB residues in the Great Lakes I take it would be relative to data which shows the types of PCBs in fish in the Great Lakes.

A That is correct. Not solely restricted to Exhibit 2 data.

Q But it doesn't go beyond what you and others have found to be PCB residues in fish in the Great Lakes?

Ther L Urban  
Certified Shorthand Reporter  
174 S. La Salle Street

## Stalling - direct (Featherstone)

A I would answer no, in the best understanding I have of your question.

Q Fine. Chemical kinetics of PCBs, does that refer to the process of uptake and elimination of PCBs by fish?

A Yes.

Q Is it any more broad than that, chemical kinetics, when you use the term?

A Not when I am using the term, no.

Q Have you formed any opinions as to whether any species of fish take up certain isomers of PCBs more rapidly than others? I think I have asked you that earlier.

A I think the question would be the same as the previous ones. You asked that question earlier.

Q I have forgotten what the answer was. You haven't done anything on it?

A Not extensive. We have done some work in that area but -- I just have to refer back to the previous answer, the proper statement of what we have done.

Q Is your work in its early stages, basically?

A Yes.

Ther L Urban  
Certified Shorthand Reporter  
134 South 1st Street  
Cleveland, Ohio

## Stalling - direct (Featherstone)

Q I take it it's early enough that you are not prepared really to discuss it?

A Well, let's clarify one point. We are saying different species of fish, uptake of different isomers in a given species. We have already published one paper on the isomers -- uptake of isomers in a single species of fish versus what we are discussing in Exhibit 2.

Q What you are telling me is that your research with regard to whether different species of fish take up a particular isomer of PCB differently, that research isn't done and it is not in the literature?

A That is correct, from what I have done.

Q Has anybody else done anything reported in the literature?

A Yes. There is literature pertaining to that information.

Q Is it literature that you rely upon?

A I have read it, yes.

Q Well, do you think it is sound?

A Yes.

Q Do you rely upon it in rendering opinions?

A I could.

## Stalling - direct (Featherstone)

Q Do you?

A Well, I have not been asked the question before, so I guess in answering your question I would have to say I would.

Q Has there been any work done on the uptake by fish of 3,4,3,4 PCB?

A Yes, there has.

Q Has that work been done by you?

A Yes, it has.

Q What does that work show?

A That they do take up the material and it has a biological effect adverse to the organism.

Q Does your work also show that the fish eliminate the 3,4,3,4 PCBs?

A Yes.

Q Does your work show that fish eliminate other non-ortho PCBs?

A By recollection, yes.

Q Is there other work reported in the literature that also shows that fish eliminate non-ortho PCBs?

A Yes.

Q Is there any work in the literature that show that fish do not eliminate non-ortho PCBs?

Thea L. Urban  
Certified shorthand Reporter  
124 South La Salle Street  
Chicago, Illinois

## Stalling - direct (Featherstone)

A Not to my knowledge.

Q Have you done any work whether fish metabolize and eliminate the one ortho PCB?

A Yes.

Q Has that work been published?

A Yes.

Q How recently?

A A 1979 article in New York Academy of Science.

Q That is the same article in which you wrote about the 3,4,3,4 PCBs?

A That is correct.

Q Is that correct?

A That is correct.

Q Does that work show that fish eliminate one ortho PCBs?

A Yes.

Q Are you aware of any work reported in the scientific literature that show that fish do not eliminate one ortho PCBs?

A No.

Q Did the work that you reported in the literature deal with the 2,3,4,3,4 PCBs?

A By recollection I can't answer that question.

Thos L Urban  
Certified Shorthand Reporter  
174 South L. Salt Street



## Stalling - direct (Featherstone)

We had a mixture in that paper.

Q Are you aware of any work in the literature that dealt with the 2,3,4,3,4 PCBs?

A Yes.

Q That is your work?

A No.

Q Whose work?

A You asked the question --

Q I am sorry, Dr. Stalling. I am talking about the elimination. I will rephrase it.

A Okay.

Q Are you aware of any work reported in the literature concerning the ability of fish to eliminate the 2,3,4,3,4 PCB?

A By recollection I would say yes and --

Q Do you know who the author was?

A I think it's Steven Safe. There may be a Japanese worker, but I am not having good recall on that subject at this moment.

Q It is your recollection that that report showed that fish in fact eliminated the 2,3,4,3,4 PCB?

A Yes.

Thos L Urban  
Certified Shorthand Reporter  
114 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

Q Yesterday I asked you some questions about whether PCB levels in fish in Lake Michigan would continue to decline in the future. Do you remember those questions?

A Yes.

Q You answered that in your judgment the PCB levels would decline, but the rate of decline would slow in the future, is that correct?

A That is correct.

Q Do you know when the future of that rate according to you will decline?

A That was a question left open to information. I do not at this point -- I am not able to answer your question on any basis of fact.

Q In other words, you don't have the information to answer that question?

A No, I do not have.

Q I take it you likewise don't have any information that you can give us that would tell us in your judgment, anyway, how significantly the rate of decline would slow?

A No, I can't.

Q But in any event, even if you someday prove

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

Stalling - direct (Featherstone)

right in your judgment PCB levels will continue to decline, even though the rate slows?

A With the exception of catastrophic weather I mentioned.

Q That exception aside, my statement is true, is that correct?

A That is correct.

Q Do you know a fellow by the name of Edward H. Brown, Jr.?

A You'd have to refresh my memory as to where he is located.

Q Well, how about the Great Lakes Fishery Laboratory of the U.S. Fish and Wildlife Service?

A I am having trouble associating a face with the name. Okay. I apologize. My memory right now is zero.

Q You don't recognize that name at all?

A I can't recall anything associated with it. Okay?

Q Okay. It's called know your company.

A It certainly is. If the co-author on a paper is Wayne Wilford, I recall something about it.

Q Is the quality control data available for

Ther L Urban  
Certified Shorthand Reporter  
and Court Reporter

Stalling - direct (Featherstone)

the analysis that was performed in Exhibit 1?

A It certainly is, and you will probably find it, if my recollection is correct, in the publication that was enclosed from the Second International Symposium on Dioxins and Furans. There is a table in that report summarizing quality control for which this particular analyses would have been covered.

Q Is your laboratory backup data for that quality control information still available?

A I am certain it is.

Q What type of stuff do you have?

A The information supporting that quality control table.

Q Yesterday you were asked about --

A If it's not present in there, there is a table data that summarizes the QC.

Q How many hours of your time was involved in the work that is now summarized in Exhibit 2?

A I can give you an approximation.

Q Certainly.

A In excess of 120 hours.

Q Were you working on it full-time for a period?

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603

## Stalling - direct (Featherstone)

A Well, 50 percent.

Q How many man-hours are involved in the analysis that is reported in Exhibit 2?

A That information exists. Approximately \$4,000 worth of overtime, plus some additional regular staff time.

Q The time that you spent on it, was all of that time billed to the U.S. Attorney's office?

A None of it has been billed to the U.S. Attorney's office as yet.

Q Will it be billed, all of it, billed to the U.S. Attorney's office?

A The major part of it.

Q Is the funding for the research that was done and reported in Exhibit 2 coming from any source other than the U.S. Attorney's office?

A Yes. Our laboratory.

Q Now, you testified yesterday that your arrangement with the U.S. Attorney's office was so that they would not be billed for any more than \$6,000 for the work in Exhibit 2?

A That is the current memorandum of the understanding, yes.

Ther L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60604

## Stalling - direct (Featherstone)

Q I take it anything over \$6,000 would be picked up by your laboratory, is that correct?

A That has not been determined yet.

Q Picked up by somebody else, presumably.

A But it would be our laboratory, yes.

Q Do you know what the total cost of the effort involved in Exhibit 2 is?

A Yes. I can estimate it.

Q Well, give me your most reasonable or best estimate.

A Less than \$10,000.

Q How much less than \$10,000? Does it approach \$10,000?

A Probably eight, probably \$8,000.

Q Does that include your time of testifying?

A That has not been determined yet. I have no estimate on that. But yes, it would. That is partly up to you.

Q You are almost done. At least for me you are almost done.

Would you take a look at Table 4 in Exhibit 2.

A Yes.

Q There was some discussion when Mr. Pope was

## Stalling - direct (Featherstone)

asking questions on dichloro levels shown in Table 2.

A Yes.

Q I think the discussion was in reference to sample 422 and sample 423, is that right?

A Yes.

Q You have to answer audibly.

A Yes, sir.

Q Are those levels high, in your judgment?

A Well, they represent an appreciable percentage of the Aroclors, yes, they do.

Q Do you have any explanation for that?

A I discussed that yesterday, the explanation I have.

Q What is the explanation?

A I guess in a sense I do not have a detailed explanation for that, other than variations in the composition of the material happened to be in the sample. You know, partition coefficient, or whatever might be involved, that I do not, I cannot explain that. That is what we observed directly.

Q In order to be able to explain that I take it you have to do additional samples and additional

Thos L Urban  
Certified Shorthand Reporter  
174 South 1st Street  
Chicago, Illinois 60607

Stalling - direct (Featherstone)  
- direct (Pope)

analysis, is that right?

A I doubt that I -- I am not saying that I can explain that. It's just the way the samples were. I am not, at this point in time, I have not attached any unique significance to it, because that is what the sample analysis showed.

Q Dr. Stalling, can you say with any reasonable degree of scientific certainty, that dredging of Waukegan Harbor or the North Ditch to eliminate PCBs will in any way reduce the level of one ortho PCBs found in fish in Lake Michigan?

A I said yesterday I have no opinion on that matter.

Q In other words, you can't make any such statement?

A I said I didn't have any opinion on the matter.

Q Fair enough. I am done.

DIRECT EXAMINATION

BY MR. POPE:

Q Have you ever testified before?

A Yes. I had indicated yesterday we did. In New York, General Electric. That was a previous

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603



## Stalling - direct (Pope)

question yesterday.

Q Just answer the question.

A Okay. Yes.

Q Once?

A Twice -- no.

Q One case?

A No.

Q Tell me how many times you have testified?

A My recollection, twice.

Q Both of those in court?

A Yes.

Q As opposed to a deposition like this?

A That is correct.

Q Both of them involved General Electric?

A No.

Q Tell me what they involved?

A One involved General Electric, in the case of the State of New York against PCB pollution on the Hudson River, and the second -- the first one involved cancellation of DDT. And that was an administrative hearing, as I recall.

Q Both of them were?

A No. The first one was a court administrative

Ther L Urban  
Certified Shorthand Reporter  
124 South La Salle Street  
Chicago, Illinois 60601

## Stalling - direct (Pope)

-- It had an administrative judge, Judge Sweeney.

Q Neither of them were actually in court?

A It was held in a courtroom. Okay.

Q But there was no judge there, I mean,  
officially designated judge.

A I couldn't answer your question.

Q That is the only two times that you have  
ever testified before?

A That is correct.

Q Do you have any plans to do any further  
work in connection with your testimony in this case?

A I have not determined that.

Q Pardon me?

A I have not determined that at the moment.

Q Well, as you sit here today, you either  
have some plans or you don't have any plans.

A I have a couple of things I would like to  
do.

Q Like what?

A Probably look at some confirmation of ortho  
chlorene residues.

Q What does that mean, confirmation?

A There were some questions raised yesterday

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois

## Stalling - direct (Pope)

that I can answer.

Q Regarding what?

A The questions concerning the detection of the penta and hexa non-ortho substituted PCBs.

Q Anything else you have ideas about doing further work on in connection with this case?

A I will definitely work on the composition of PCBs in the fish from the National Pesticide Monitoring Program that are reported here, but indirectly would not be part -- would be part of our research program.

Q Anything else?

A Not that I can currently recall.

Q I understand you told Mr. Featherstone this morning the isomers with which you feel a special concern in the PCB area are found in Aroclor 1242 and 1248, is that true?

A Yes.

Q In both?

A To my recollection, yes.

Q Is your concern based on public reports?

A Yes.

Q Done by other people?

A Yes, sir.

Ther L Urban  
Certified Shorthand Reporter  
174 S. 11th, Chicago, Ill.

## Stalling - direct (Pope)

Q When were --

A But not solely.

Q What do you mean by that?

A I have done some work with some company.

Q And you have published results of that work?

A That is right. That is in the literature.

Q When is the first such article published, when was it published, either of yours or of someone else's, that gives rise to your concerns or the basis for it?

A It originates with publications by Dr. Alan Poland.

Q When was that first published?

A An estimation, 1975.

Q What was the nature of his work?

A It concerned the interaction of dioxins and isosteric compounds, such as dibenzofurans and PCBs with the AHH locus, which is an enzyme system ultimately resulted in arylhydrocarbon hydroxylase activity.

MR. FEATHERSTONE: That is what is being debated. That is what the motion is about.

MR. POPE: I understand.

It would be my intention, Mr. White, if it

Thea L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Ill. 60603

Stalling - direct (Pope)

is acceptable to you, rather than going into any other articles that form the basis of his opinion, the published materials, that we could confer afterwards, next week or sometime, either by interrogatory or informally, so we could work ourselves and make sure we have a list of the articles that in fact form the basis of Dr. Stalling's opinion. Is that acceptable to you?

MR. WHITE: Yes.

BY MR. POPE:

Q Dr. Stalling, you were present at a symposium in Washington when Dr. Steve Safe spoke, were you not?

A Yes, I was.

Q That is the same Dr. Safe you have been referring to as a toxicologist whose work forms a partial basis of your opinion, is that correct?

A Yes.

Q That was in May 12-13 of this year?

A To my recollection, yes.

Q Would you agree with me that in his presentation Dr. Safe said the following things are "not really understood. Structure activity relationships to PCBs." Do you agree with that?

Thos L Urban  
Certified Shorthand Reporter  
174 South 1st St  
St. Louis, Mo

## Stalling - direct (Pope)

A Did he say not fully understood?

Q Not really understood, is my recollection.

A Well, I certainly agree they are not fully understood, nor are they totally really understood. Okay.

Q The same question with regard to the mechanism of the action.

A That is for certain.

Q And the question of occupational exposure, did he also say that?

A I have no opinion on that subject.

Q You have no opinion as to whether he said that was really not understood?

A By recollection, I don't recall that particular statement.

Q How about subacute toxic affects, did he say that really wasn't understood?

A Again, by recollection, I do not recall those specific comments.

Q How about environmental exposure and chronic toxic effects, did he say that really wasn't understood?

A He made comments pertaining to that, yes.

Q To the effect that that really wasn't understood at this point in time?

Theo L. Urban  
Certified Shorthand Reporter  
134 South La Salle Street

## Stalling - direct (Pope)

A Yes. If I totally understood, yes.

Q How about the combined effect of PCBs without the chemicals and toxic effects, did he say that really wasn't understood?

A Again, I can't recall the specifics of those statements, other than what I did agree by recollection.

Q You don't recall whether he said --

A I don't recall that particular statement, your last question.

Q Okay.

A Nor have I read the proceedings of that congress or symposium.

MR. POPE: Subject to Mr. Featherstone and subject also to the question of whether the witness is going to do any further work in this area which may give rise to a supplemental deposition, I have no more questions today.

MR. WHITE: Thank you. That is it.

(Witness excused.)

AND FURTHER DEPONENT SAITH NOT.

IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF ILLINOIS  
EASTERN DIVISION

THE UNITED STATES OF AMERICA,	)	
	)	
Plaintiff,	)	
	)	
vs.	)	No. 78 C 1004
	)	
OUTBOARD MARINE CORPORATION	)	
and MONSANTO COMPANY,	)	
	)	
Defendants.	)	

I hereby certify that I have read the foregoing transcript of my deposition given at the time and place aforesaid, consisting of Pages 1 to 259, inclusive, and I do again subscribe and make oath that the same is a true, correct and complete transcript of my deposition so given as aforesaid, as it now appears.

\_\_\_\_\_  
DR. DAVID STALLING

SUBSCRIBED AND SWORN TO  
before me this \_\_\_\_ day  
of \_\_\_\_\_,  
A.D. 1982.

\_\_\_\_\_  
Notary Public

Ther L Urban  
Certified Shorthand Reporter  
134 South La Salle Street  
Chicago, Illinois 60603



N 90319

A RUEHL, DW; DOUGHERTY, RC; TONDEUR, Y;  
A STALLING, DL; SMITH, LM; RAFFE, C

(OMC)  
Stalling SEP. EX. NO. 5  
FOR ID. NO. OF 9/9/82  
JPS

T NEGATIVE CHEMICAL IONIZATION STUDIES OF  
T POLYCHLORINATED DIBENZO-P-DIOXINS, DIBENZO-  
T FURANS AND NAPHTHALENES IN ENVIRONMENTAL  
T SAMPLES

P

S PAGES 245-61 IN JAMES D MCKINNEY, ED.  
S ENVIRONMENTAL HEALTH CHEMISTRY. ANN ARBOR

SCIENCE, ANN ARBOR, MI., 1991. 500 P.

N 90810

A FRALEY, DM; YATES, DA; MANAHAN, SE; STALLING, DL  
A PETTY, JD

T ICP-AES AS A MULTIPLE ELEMENT DETECTOR FOR METAL CHELATES  
T SEPARATED BY HPLC.

S APPLIED SPECTROSCOPY

N CNFRL; MANUSCRIPTS; IN-PRESS; 908.02; CHEMISTRY; 1/82

N 90709

A GOLDSTEIN, JA; LINNO, P; HUCKINS, JN; STALLING, DL

T STRUCTURE-ACTIVITY RELATIONSHIPS OF CHLORINATED

T BENZENES AS INDUCERS OF MULTIPLE FORMS OF CYTOCHROME P-450

T IN RAT LIVER

S BIOCHEMICAL PHARMACOLOGY

N CNFRL; MANUSCRIPTS; DRAFT; 11/81; CHEMISTRY

P

N 90350

A MITCHUM, RK; NORFMACHER, WA; HOLER, GF; STALLING, DL  
T CAPILLARY GAS CHROMATOGRAPHY/ATMOSPHERIC PRESSURE  
T NEGATIVE CHEMICAL IONIZATION MASS SPECTROMETRY OF THE  
T 22 ISOMERIC TETRACHLORODIBENZO-P-DIOXINS  
S ANALYTICAL CHEMISTRY 54: 719-22, 1982

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N 90320

A RAPPE, C; BUSER, HR; STALLING, DL;  
A SMITH, LM; DOUGHERTY, RC  
T IDENTIFICATION OF POLYCHLORINATED DIBENZO-  
T FURANS IN ENVIRONMENTAL SAMPLES  
S NATURE, 292: 524-26, 1981

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A STALLING, DL; PETTY, JD; DUBAY, GR; SMITH, RA  
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T OF AROMATICS USING CARBON AS THE STATIONARY PHASE  
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S 1980

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T COMPOUNDS FROM ORGANIC SOLVENTS USING  
T ALKALI METAL SILICATES  
S JOURNAL OF CHROMATOGRAPHIC SCIENCE,  
S 19: 18-26, 1981

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A STALLING, DL; PETTY, JD; SMITH, LM; RAFFE, C  
A BUSER, HR  
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S SYMPOSIUM ON CHLORINATED DIOXINS AND RELATED  
S COMPOUNDS, PERGAMON PRESS, OXFORD, ENGLAND  
N CNERL; MANUSCRIPTS; IN-PRESS; 11/81; CHEMISTRY  
N 904.01

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N 90751

A STALLING, DL; SMITH, LM; PETTY, JD; HOGAN, JW  
A JOHNSON, JL; RAFFE, C; BUSER, HR  
T RESIDUES OF POLYCHLORINATED DIBENZO-P-DIOXINS  
T (PCDDs) AND DIBENZOFURANS (PCDFs) IN LAURENTIAN GREAT  
T LAKES FISH  
S PROC. 2ND INT. CONF. ON DIOXINS AND RELATED COMPOUNDS  
N CNERL; MANUSCRIPTS; DRAFT; 12/81; CHEMISTRY

A

N 90741

A RAFFE, C; STALLING, DL; SMITH, LM; BUSER, HR

T OCCURENCE OF POLYCHLORINATED DIOXINS AND DIBENZOFURANS  
T IN THE BALTIC SEA

S SWEDISH CHEMISTRY JOURNAL

K CNFRL; MANUSCRIPTS; IN-PRESS; ORIGINAL IN SWEDISH; 11/81

K CHEMISTRY

N 90351

A RIBICK, MA; DUBAY, GR; PETTY, JD; STALLING, DL;

A SCHMITT, CJ

T TOXAPHENE RESIDUES IN FISH; IDENTIFICATION, QUANTIFI-  
T CATION, AND CONFIRMATION AT PART PER BILLION LEVELS

S ENVIRONMENTAL SCIENCE AND TECHNOLOGY 16: 310-18, 1982

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A RIBICK, MA; SMITH, LM; DUBAY, GR; STALLING, DL

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T METHODS USED IN MONITORING ENVIRONMENTAL

T CONTAMINANTS

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Samples designated F160, F161, F162, and F163 (CNFRL) found in Appendix C were not identified in the report summary because information on their origin and residue levels was not available to Dr. Stalling at the time he prepared the report. These four samples were provided to CNFRL by Mr. Wayne Wilford of the Great Lakes Fishery Laboratory (GLFL), Ann Arbor, Michigan. They were extracts of subsamples of a large composite sample, prepared by grinding and mixing tissue from 20 adult lake trout (7620 mm) <sup>greater than 650</sup> collected at Saugatuck, Michigan in the fall of 1979. Sample identity and results are as follows:

<u>GLFRL #</u>	<u>CNFRL #</u>	<u>Residue (ng/g) Measured By</u>	
		<u>CNFRL</u>	<u>GLFL</u>
IJC-374-79	160	11.3	13.4
IJC-381-79	161	13.9	13.5
IJC-372-79	162	13.3	15.2
IJC-395-79*	163	<u>15.2</u>	<u>13.9</u>
		average 13.4	13.4

\* Erroneously identified on CNFRL Report labels as IJC-372-79 in Appendix C

The results illustrate that comparable results can be obtained for total PCB concentration measured by conventional methodology (packed columns were used by GLFL) and the isomer specific method based on capillary column chromatography employed by CNFRL.

*Stalling* (O.M.C.)  
 SEP. EX. NO. 3  
 FOR ID. AS OF 9/9/82  
*gs*

Isomer Specific Composition of PCB Residues in Fish and Sediment  
from Waukegan Harbour and Other Great Lakes Fish

Columbia National Fisheries Research Laboratory  
U. S. Fish and Wildlife Service  
Route 1, Columbia, Missouri 65201  
(314) 875-5399 FTS 276-5399

For technical information contact:

Dr. David L. Stalling, Chief Chemist  
August 19, 1982

*Stalling* (Mussato)  
SEP. EX. NO. 2  
FOR ID., AS OF 9/9/82  
*gls*

## **6. Appendices**

### **Appendix A**

- (I). Composition of Aroclor 1242, 1248, 1254, and 1260.
- (II). Linear Regression Summary - Aroclor 1:1:1:1 Mixture.
- (III). Analysis of Aroclor 1248
- (IV). Quality Control Data for the Analytical Method.

### **Appendix B**

PCB Residues in Fish and Sediment Samples Submitted  
by The Environmental Protection Agency.

### **Appendix C**

PCB Residues in Selected Fish Samples  
Collected from the Great Lakes as Part of  
the National Pesticide Monitoring Program.

### **Appendix D**

Residues of non-ortho-, ortho'-chlorine substituted PCBs  
in Fish and Sediment Samples

Laboratory Report

Methods Section

Columbia National Fisheries Research Laboratory

Analysis of Fish Samples from the Harbor at Waukegan

Illinois for PCDF and PCDD

Residues

From: Lawrence M. Smith  
James L. Johnson  
Nov. 25, 1981  
To: Chief Chemist, CNFRL

Two samples of single, ground whole fish from the harbor at Waukegan, Illinois were received May 14, 1981 from William Sargent, Jr. (EPA Surveillance and Analysis Division, 536 S. Clark St., Chicago, IL, 60605, FTS #353-9083). The samples were processed and analyzed by established procedures employed at CNFRL for polychlorinated dibenzofurans (PCDFs), dioxins (PCDDs) and also PCBs isomers possessing no ortho chlorine substituents.

The results of these determinations are given in the following tables.

cc: Gardebring  
Walker  
Jacobs  
DiDomenico  
Vanderlaan  
Hynes  
Swain  
Veith  
Nisbet      AU  
            Loemer

(Dist. 1/15/82)

(Mussato)  
SEP. EX. NO. 1-44  
FOR EX. AS OF 9/9/82  
JGL

Table 1. PCDFs, PCDDs and non-ortho PCBs Residue Levels in Fish,  
EPA 81-NFO0548 (S),  
carp, single fish

<u>PCDFs (pg/g)</u>					
<u>Cl<sub>4</sub></u>	<u>Cl<sub>5</sub></u>	<u>Cl<sub>6</sub></u>	<u>Cl<sub>7</sub></u>	<u>Cl<sub>8</sub></u>	<u>Σ</u>
29	3	ND	ND	ND	32
[2378] [12678]					
(2)	(2)	(5)	(10)	(10)	(10)
<u>PCDDs (pg/g)</u>					
<u>Cl<sub>4</sub></u>	<u>Cl<sub>5</sub></u>	<u>Cl<sub>6</sub></u>	<u>Cl<sub>7</sub></u>	<u>Cl<sub>8</sub></u>	<u>Σ</u>
ND	ND	ND	ND	ND	ND
(1)	(1)	(2)	(2)	(2)	(2)
non-ortho PCBs (pg/g)					
<u>3,4,3',4'-Cl<sub>4</sub></u>	<u>3,4,5,3',4'-Cl<sub>5</sub></u>	<u>3,4,5,3',4,5-Cl<sub>6</sub></u>			
2300	4700	200			

Table 2.  
PCDFs, PCDDs and non-ortho PCBs Residue Levels in  
Fish, EPA 81-NFOOS49 (S),  
L.M. Bass, single fish

<u>PCDFs (pg/g)</u>					
<u>Cl<sub>4</sub></u>	<u>Cl<sub>5</sub></u>	<u>Cl<sub>6</sub></u>	<u>Cl<sub>7</sub></u>	<u>Cl<sub>8</sub></u>	<u>Σ</u>
68	2+7+19	2	ND	ND	98
[2,3,7,8] [3 isomers]					
(2)	(2)	(2)	(10)	(10)	
<u>PCDDs (pg/g)</u>					
<u>Cl<sub>4</sub></u>	<u>Cl<sub>5</sub></u>	<u>Cl<sub>6</sub></u>	<u>Cl<sub>7</sub></u>	<u>Cl<sub>8</sub></u>	<u>Σ</u>
ND	ND	3	ND	34	37
(1)	(1)	(2)	(2)	(2)	
<u>non-ortho PCBs (pg/g)</u>					
<u>3,4,3',4'-Cl<sub>4</sub></u>	<u>3,4,5,3',4'-Cl<sub>5</sub></u>	<u>3,4,5,3',4',5'-Cl<sub>6</sub></u>			
400	200	300			



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Numbers in brackets refer to the isomer identifications. Numbers in parenthesis are the detection limit at a signal-to-noise levels of three.

The isomer assignment for 2,3,7,8-tetrachlorodibenzofuran (TCDF) is tentative and based on best available analytical capabilities; all 37 TCDF isomers are not available for rigorous isomer identification.

**Isomer Specific Composition of PCB Residues in Fish and Sediment  
from Waukegan Harbour and Other Great Lakes Fish**

**Appendix A**

- (I). Composition of Aroclor 1242, 1248, 1254, and 1260.
- (II). Linear Regression Summary - Aroclor 1:1:1:1 Mixture.
- (III). Analysis of Aroclor 1248
- (IV). Quality Control Data for the Analytical Method.

**Columbia National Fisheries Research Laboratory  
U. S. Fish and Wildlife Service  
Route 1, Columbia, Missouri 65201  
(314) 875-5399 FTS 276-5399**

**For technical information contact:**

**Dr. David L. Stalling, Chief Chemist**

**August 19, 1982**

TRESA/7/72 10-48-02 10:46 AM  
 Particle number 00  
 Lab code  
 App. number  
 Collection date  
 Starting time  
 Ending time  
 Lipid or Biotin  
 Control 0  
 REF. 001L SPICED AT SPOE MODULE 1200

EC  
 1  
 Sample mass  
 20 g  
 Sample volume  
 10 ml  
 Injected volume  
 3 ul  
 Dilution factor  
 10

0.1  
 0.2  
 0.3  
 0.4  
 0.5  
 0.6  
 0.7  
 0.8  
 0.9  
 1.0  
 1.1  
 1.2  
 1.3  
 1.4  
 1.5  
 1.6  
 1.7  
 1.8  
 1.9  
 2.0  
 2.1  
 2.2  
 2.3  
 2.4  
 2.5  
 2.6  
 2.7  
 2.8  
 2.9  
 3.0  
 3.1  
 3.2  
 3.3  
 3.4  
 3.5  
 3.6  
 3.7  
 3.8  
 3.9  
 4.0  
 4.1  
 4.2  
 4.3  
 4.4  
 4.5  
 4.6  
 4.7  
 4.8  
 4.9  
 5.0  
 5.1  
 5.2  
 5.3  
 5.4  
 5.5  
 5.6  
 5.7  
 5.8  
 5.9  
 6.0  
 6.1  
 6.2  
 6.3  
 6.4  
 6.5  
 6.6  
 6.7  
 6.8  
 6.9  
 7.0  
 7.1  
 7.2  
 7.3  
 7.4  
 7.5  
 7.6  
 7.7  
 7.8  
 7.9  
 8.0  
 8.1  
 8.2  
 8.3  
 8.4  
 8.5  
 8.6  
 8.7  
 8.8  
 8.9  
 9.0  
 9.1  
 9.2  
 9.3  
 9.4  
 9.5  
 9.6  
 9.7  
 9.8  
 9.9  
 10.0

Peak	RT	Label	RT/Label	Structure	F1	Area	RA	RI	CI
4	2.008	2	1	2.4'	.0206	71333	.347041	.007149	1.19E-02
7	.0401	2	2	2.2'.5	.0448	507277	3.505458	.14045	3.72E-01
8	.0794	2	2	2.2'.4	.0150	200317	2.465480	.004783	6.71E-02
9	.0839	2	2	2.2'.3	.0152	202444	1.470709	.02320	4.20E-02
10	.0157	2	2	2.4'.6	.0076	321007	3.547022	.034059	5.47E-02
12	.0793	4	3	2.2'.6.6	.0042	191805	5.545440	.033302	5.72E-02
13	.0816	2	1	2'.6.5	.0076	372749	5.207153	.040750	6.70E-02
14	.0110	2	1	2.3'.4	.0040	107404	4.370017	.017516	2.91E-02
15	.0270	2	1	2.4'.5	.0377	1309200	4.704133	.161944	2.49E-01
16	.0370	2	1	2.4'.5	.0313	204710	4.974019	.135274	2.59E-01
17	.0512	2	1	2'.2.4	.0166	423319	3.540037	.037620	6.27E-02
18	.0672	4	2	2.2'.5.5'	.0423	1655010	4.032442	.201042	5.01E-01
19	.0710	4	2	2.2'.6.5'	.0276	1037960	5.070900	.133604	3.21E-01
20	.0737	4	2	2.2'.3.5'	.0574	2240700	5.433335	.022353	5.20E-01
21	.0737	4	2	2.2'.6.4'	.0000	402041	6.530023	.052247	8.70E-02
22	.0743	4	2	2.2'.3'.4	.0005	707407	6.190376	.052410	8.70E-02
23	.0701	4	2	2.2'.3'.3'	.0125	973040	5.720343	.071270	1.19E-01
24	.0700	4	2	2.2'.3.1'	.0075	770613	6.390409	.060710	1.01E-01
25	.0747	4	2	2.3'.4'.6	.0175	1534000	6.119075	.072703	1.65E-01
27	.0227	5	3	2.2'.3.5'.6	.0429	653441	1.695775	.072703	1.21E-01
28	.0541	5	3	2.2'.3.3'.6	.0107	424723	3.042292	.027472	5.44E-02
29	.0075	4	1	2.3'.4'.5	.0351	2334340	5.231650	.102965	3.46E-01
30	.0703	4	1	2.3'.4'.5'	.0100	1126470	5.504753	.053300	9.30E-02
31	.0040	4	1	2.3'.3'.4	.0752	2372600	6.117103	.154151	3.54E-01
32	.0775	4	1	2.3'.4.4'	.0112	1374340	6.035449	.067507	1.12E-01
33	.0715	5	2	2.2'.3.5.5'	.0234	1475030	7.474240	.174373	2.93E-01
35	.0700	5	2	2.2'.6.5.5'	.0540	1034130	1.007706	.101344	1.60E-01
36	.0070	5	2	2.2'.6.4'.5	.0176	611195	3.294462	.057904	9.44E-02
38	.0716	5	2	2.2'.3.6.5'	.0172	1653910	2.710054	.032072	5.51E-02
39	.0706	5	2	2.3'.3'.6.4	.0571	2717050	2.570574	.142795	2.65E-01
42	.0819	6	3	2.2'.3'.6.4.5	.0405	702619	.290502	.014401	2.41E-02
43	.01619	5	3	2.3'.4.4'.5	.0274	1553490	2.119535	.060109	1.00E-01
44	.01152	5	1	2.3'.3'.6.4'	.0042	1207160	4.271511	.024793	4.44E-02
47	.02222	6	2	2.2'.6.4.4'.5.5'	.0475	350367	.072770	.000940	1.61E-03
49	.0204	6	2	2.2'.3.4.4'.5.5'	.0273	653440	.232307	.004344	1.09E-02
51	.02099	7	3	2.2'.3.4.4'.5.5'.6	.0145	140944	.253415	.004345	6.13E-03
52	.02130	7	3	2.2'.3.3'.4.4'.5.6	.0000	713037	.091599	.000412	6.07E-04
53	.02232	8	4	2.2'.3.3'.5.5'.6.6.6'	.0070	61064	.303370	.000234	3.52E-03
61	.02270	8	3	2.2'.3.3'.6.5.5'.6.6'	.0075	61910	.041314	.000172	2.00E-04
64	.02500	8	3	2.2'.3.4.4'.5.5'.6.6	.0075	20076	.041320	.000100	1.00E-04

Total  
 Unlabeled  
 unlabeled

3.000735  
 2.072409

5.01E+00  
 4.75E+00

US 53710

**Isomer Specific Composition of PCB Residues in Fish and Sediment  
from Waukegan Harbour and Other Great Lakes Fish**

**Appendix D**

**Residues of non-~~ortho~~-, ~~ortho~~'-chlorine substituted PCBs  
in Fish and Sediment Samples**

**Columbia National Fisheries Research Laboratory  
U. S. Fish and Wildlife Service  
Route 1, Columbia, Missouri 65201  
(314) 875-5399 FTS 276-5399**

**For technical information contact:**

**Dr. David L. Stalling, Chief Chemist  
August 26, 1982**

Control #  
Site

FISH SOLVENT BLANK SPIKED WITH  
0.103 ppm NON-ORTHO ISOMERS

peak	RRT	Chlorines		structure	Fi	area	HL	Hi ng	Cl ug/s
		total	ortho						
1	1.1212	4	0	3,3',4,4'	.1800	3128670	1.497911	.269624	1.79E-02
2	1.4728	5	0	3,3',4,4',5	.5220	15109900	2.239264	1.168896	7.79E-02
3	1.9765	6	0	3,3',4,4',5,5'	.2690	18547000	2.187691	.588489	3.92E-02

Total  
unwindowed 2.027009 1.35E-01  
windowed 2.027009 1.35E-01

#### Unwindowed Matrix

PCB Concentrations in Micrograms/gram  
[Percent of Total Residue]

#### Ortho Chlorines

Cl #	0	1	2	3	4	Total Cl (ug/s)
1						0 [0.0]
2						0 [0.0]
3						0 [0.0]
4	.0179 [13.3]					.0179 [13.3]
5	.0779 [57.7]					.0779 [57.7]
6	.0392 [29.0]					.0392 [29.0]
7						0 [0.0]
8						0 [0.0]
9						0 [0.0]
10						0 [0.0]

.135 0 0 0 0 .135  
[100.0] [0.0] [0.0] [0.0] [0.0] [100.0]

US 54126

**Isomer Specific Composition of PCB Residues in Fish and Sediment  
from Waukegan Harbour and Other Great Lakes Fish**

**Appendix B**

**PCB Residues in Fish and Sediment Samples Submitted  
by the Environmental Protection Agency**

**Columbia National Fisheries Research Laboratory  
U. S. Fish and Wildlife Service  
Route 1, Columbia, Missouri 65201  
(314) 875-5399 FTS 276-5399**

**For technical information contact:**

**Dr. David L. Stalling, Chief Chemist  
August 19, 1982**

TEST/ID: 18-AUG-82 10:44 AM  
 Sample number: 83 Method code: 1  
 Lab code: 8425 (3) B.C. Parameter: 1  
 Rep. number: 1 Sample mass: 29.16 g  
 Collection date: 9 Sample volume: 10 ml  
 Start time: 19:21:13 Injected volume: 3 ul  
 End time: 20:25:43 Dilution factor: 25  
 Lipid or Water: 0 X  
 Control: 810029500  
 Site: EPA - WAJUEGAN HARBOR

peak	RT	Chlorines		structure	FI	area	RI	MS	CI
		total	ortho					ms	ms/s
1	.2673	2	2	2,2'	.0098	86787	16.333095	.162270	0.63E-01
2	.3588	2	1	2,3	.0012	25783	4.171721	.005005	1.43E-02
3	.3689	2	1	2,4	.0046	426460	17.197699	.079189	2.76E-01
4	.3772	2	1	2,3'	.0029	232092	20.183142	.058531	1.67E-01
5	.3891	2	1	2,4'	.0206	476873	3.168706	.104175	3.04E-01
7	.4647	3	2	2,2',3	.0448	1365710	10.263735	.000343	1.37E+00
8	.4802	3	2	2,2',4	.0150	1641040	17.354690	.266320	7.43E-01
9	.4862	3	2	2,2',3	.0152	425334	4.058839	.061694	1.76E-01
10	.5164	3	2	2,4',4	.0096	1572040	10.421853	.176842	5.03E-01
11	.5334	2	0	4,4'	.0039	50745	14.093052	.051963	1.57E-01
12	.5800	4	3	2,2',4,4	.0042	740649	20.299013	.125798	3.39E-01
13	.6002	3	1	2',3,5	.0076	1976400	20.549750	.156170	4.46E-01
14	.6114	3	1	2,3',4	.0040	2398160	41.718527	.166874	0.76E-01
15	.6247	3	1	2,4',5	.0377	3416250	11.920383	.049398	1.28E+00
16	.6385	3	1	2,4,4'	.0313	4394620	9.737764	.304792	0.71E-01
17	.6516	3	1	2',3,4	.0104	1235910	7.318572	.077492	2.21E-01
18	.6925	4	2	2,2',3,5'	.0623	2834750	9.760046	.600051	1.73E+00
19	.7139	4	2	2,2',4,5'	.0226	2067100	16.976350	.302501	1.09E+00
20	.7196	4	2	2,2',3,5'	.0574	2375410	5.670608	.325493	9.30E-01
21	.7382	4	2	2,2',4,4'	.0080	2004260	10.752464	.150020	4.70E-01
22	.7437	4	2	2,2',3,4'	.0085	1483400	13.203727	.117232	3.20E-01
23	.7488	4	2	2,2',3,3'	.0125	1007730	4.289882	.078624	2.24E-01
24	.7589	4	2	2,2',3,4	.0095	1602850	13.942598	.132453	3.70E-01
25	.7752	4	2	2,3,4',4	.0159	2000170	8.437048	.134149	3.83E-01
26	.8059	3	0	3,4,4'	.0034	223928	10.014444	.036769	1.65E-01
27	.8231	5	3	2,2',3,5',4	.0429	878140	2.402934	.163084	2.94E-01
28	.8541	5	3	2,2',3,3',4	.0167	789413	5.047767	.042571	1.70E-01
29	.8896	4	1	2,3',4',5	.0251	2369120	5.322134	.186007	5.33E-01
30	.8986	4	1	2,3,4',5'	.0100	1532570	7.728495	.077205	2.20E-01
31	.9039	4	1	2,3,3',4	.0252	2998530	7.702307	.194098	5.54E-01
32	.9172	4	1	2,3,4,4'	.0112	1590010	7.007244	.078481	2.24E-01
33	.9313	5	2	2,2',3,5,5'	.0236	1287800	6.527756	.153937	4.39E-01
34	.9350	6	4	2,2',3,3',4,4'	.0002	693816	4.142091	.000828	2.36E-03
35	.9593	5	2	2,2',4,5,5'	.0540	1507490	7.729463	.152850	4.36E-01
36	.9829	5	2	2,2',4,4',5	.0176	801065	4.413978	.077684	2.72E-01
38	.9911	5	2	2,2',3,4,5'	.0122	1525030	2.846484	.034703	9.91E-02
39	1.0202	5	2	2,3,3',4,4	.0571	4044530	4.028270	.230014	6.57E-01
40	1.0496	6	3	2,2',3,3',5,6	.0192	463532	1.100726	.022014	6.51E-02
41	1.0717	6	3	2,2',3,3',5,6	.0021	72044	.902282	.001095	5.41E-03
42	1.0817	6	3	2,2',3',4,5,6'	.0485	969485	1.445181	.071061	2.03E-01
43	1.1177	6	3	2,2',3,3',4,6'	.0144	330960	.958473	.013801	3.74E-02
44	1.1383	5	1	2,3',4',5,5'	.0044	100064	.845719	.063721	1.04E-02
45	1.1613	5	1	2,3',4,4',5	.0274	2453920	3.471326	.095114	2.71E-01
46	1.1933	5	1	2,3,3',4,4'	.0042	2039210	6.004655	.042685	1.21E-01
47	1.2220	6	2	2,2',4,4',5,5'	.0425	1162940	.710100	.030179	0.62E-02
48	1.2346	7	4	2,2',3,3',4,6,6'	.0004	66630	1.237783	.000495	1.41E-03
49	1.2560	6	2	2,2',3,4,4',5'	.0273	1773400	1.239957	.033851	9.67E-02
50	1.2728	6	2	2,2',3,3',4,5	.0033	277539	1.077752	.002557	1.01E-02
51	1.2998	7	3	2,2',3,4,4',5',6	.0145	835043	1.196142	.017344	4.95E-02
52	1.3147	7	3	2,2',3,3',4',5,6	.0080	470426	.735148	.005881	1.68E-02
53	1.3232	8	4	2,2',3,3',5,5',6,6'	.0070	347739	.999595	.006997	1.99E-02
54	1.3359	7	3	2,2',3,3',4,4',6	.0024	432540	1.382934	.001319	9.40E-03
55	1.3604	8	4	2,2',3,3',4,5',6,6'	.0048	159754	.935048	.004584	1.31E-02
56	1.3941	6	1	2,3,4,4',5,5'	.0001	126017	.900119	.000049	1.97E-04
57	1.4280	6	1	2,3,3',4,4',5	.0028	458743	1.697445	.004753	1.23E-02
58	1.4448	7	2	2,2',3,3',4,5,5'	.0001	74904	.668656	.000037	1.07E-04
60	1.5034	7	2	2,2',3,3',4,4',5	.0096	833294	1.096335	.010527	3.00E-02
61	1.5217	8	3	2,2',3,3',4,5,5',6'	.0025	621441	1.728778	.004322	1.23E-02
62	1.5298	8	3	2,2',3,3',4,4',5,5',6	.0013	168105	.871173	.001133	3.23E-03
63	1.5448	8	3	2,2',3,3',4,4',5,6'	.0020	174206	.837802	.001676	4.70E-03
64	1.5582	8	3	2,2',3,4,4',5,5',6	.0025	356932	1.538370	.002846	1.09E-02
65	1.5954	8	3	2,2',3,3',4,4',5,6	.0016	178457	.955719	.001529	4.36E-03
67	1.6563	7	1	2,3,3',4,4',5,5'	.0000	16432	1.488437	.000015	4.25E-05
68	1.7154	8	2	2,2',3,3',4,4',5,5'	.0011	727138	2.001829	.002290	6.54E-03

Total

US 53772

**Isomer Specific Composition of PCB Residues in Fish and Sediment  
from Waukegan Harbour and Other Great Lakes Fish**

**Appendix C**

**PCB Residues in Selected Fish Samples  
Collected from the Great Lakes as Part of  
the National Pesticide Monitoring Program.**

**Columbia National Fisheries Research Laboratory  
U. S. Fish and Wildlife Service  
Route 1, Columbia, Missouri 65201  
(314) 875-5399 FTS 276-5399**

**For technical information contact:**

**Dr. David L. Stalling, Chief Chemist  
August 19, 1982**



TSSB/8/82 10-AUG-82 1011Z AM  
 Recycle number 22 Method code 1  
 Lab code F163 B.C. parameter 1  
 Run number 1 Sample base 10 d  
 Collection date 1979 Sample volume 10 ml  
 Starting time 00:04:20 Injected volume 3 ul  
 Ending time 01:10:47 Dilution factor 25  
 Lipid or Water 0.2  
 Control 0 IJC-372-79  
 Site AMN ARBOR REY.

peak	RET	Chlorines		structure	FI	area	RL	RL	CI
		Total	ortho				mg	mg/g	ml/g
8	.4838	3	2	2,2',4	.0150	154767	1.353793	.020307	1.69E-01
13	.6051	3	1	2',3,5	.0076	1894	1.532964	.011450	9.70E-02
16	.6375	3	1	2,4,4'	.0313	208727	1.167787	.034552	3.04E-01
18	.6935	4	2	2,2',3,5'	.0423	316884	.762545	.047508	3.93E-01
19	.7148	4	2	2,2',4,5'	.0226	280471	1.293448	.027232	2.43E-01
20	.7201	4	2	2,2',3,5'	.0574	282948	.368490	.021163	1.76E-01
21	.7390	4	2	2,2',4,4'	.0088	234941	2.514718	.020118	1.67E-01
22	.7443	4	2	2,2',3',4	.0085	79526	.512966	.004340	3.63E-02
25	.7757	4	2	2,3,4',6	.0159	379923	1.281493	.028376	1.89E-01
27	.8236	5	3	2,2',3,5',6	.0429	359732	.777680	.033362	2.78E-01
29	.8893	4	1	2,3',4',5	.0351	881476	1.818159	.063537	5.29E-01
30	.8988	4	1	2,3,4',5'	.0180	562325	2.602999	.026630	2.16E-01
31	.9039	4	1	2,3,3',4	.0252	1219030	3.040820	.076810	6.40E-01
32	.9170	4	1	2,3,4,4'	.0112	218259	.767918	.008401	7.16E-02
33	.9313	5	2	2,2',3,5,5'	.0236	403824	2.047148	.048313	4.02E-01
34	.9357	6	4	2,2',3,3',6,6'	.0002	552712	3.273375	.000455	5.45E-03
35	.9591	5	2	2,2',4,5,5'	.0560	1582370	2.875575	.161832	1.34E+00
36	.9826	5	2	2,2',4,4',5	.0176	1171030	6.594984	.116072	9.67E-01
38	.9987	5	2	2,2',3,4,5'	.0122	1242480	2.298238	.028039	2.33E-01
39	1.0199	5	2	2,3,3',4,6	.0571	3239610	3.140872	.179344	1.49E+00
40	1.0491	6	3	2,2',3,3',5,6	.0192	790025	2.181777	.040354	3.36E-01
41	1.0712	6	3	2,2',3,3',5,6	.0021	134252	1.642020	.003448	2.87E-02
42	1.0887	6	3	2,2',3',4,5,6'	.0485	1414250	2.220584	.187598	8.97E-01
43	1.1170	6	3	2,2',3,3',4,6'	.0144	530542	1.685609	.024264	2.02E-01
44	1.1375	5	1	2,3',4',5,5'	.0044	157237	1.383875	.005737	4.78E-02
45	1.1600	5	1	2,3',4,4',5	.0274	3266180	4.622348	.126652	1.03E+00
46	1.1923	5	1	2,3,3',4,4'	.0042	1453680	4.989828	.030937	2.57E-01
47	1.2204	6	2	2,2',4,4',5,5'	.0425	5619190	4.507389	.191544	1.59E+00
48	1.2402	7	4	2,2',3,3',4,6,6'	.0004	479844	5.491488	.002193	1.82E-02
49	1.2543	6	2	2,2',3,4,4',5'	.0273	6643906	4.497859	.122770	1.02E+00
50	1.2711	6	2	2,2',3,3',4,5	.0033	738455	3.161226	.018432	8.69E-02
51	1.2981	7	3	2,2',3,4,4',5',6	.0145	2233280	3.128099	.045241	3.77E-01
52	1.3127	7	3	2,2',3,3',4',5,6	.0080	858554	1.399942	.011208	9.13E-02
53	1.3211	8	4	2,2',3,3',5,5',6,6'	.0070	1170400	2.997518	.020983	1.74E-01
54	1.3337	7	3	2,2',3,3',4,4',6	.0024	836708	2.616860	.006280	5.23E-02
55	1.3584	8	4	2,2',3,3',4,5',6,6'	.0048	395827	2.338744	.011226	9.35E-02
56	1.3919	6	1	2,3,4,4',5,5'	.0001	400718	3.323607	.000233	1.93E-03
57	1.4259	6	1	2,3,3',4,4',5	.0028	989829	3.721289	.010419	8.68E-02
58	1.4424	7	2	2,2',3,3',4,5,5'	.0001	491133	3.545970	.000284	2.36E-03
59	1.4673	7	2	2,2',3,4,4',5,5'	.0250	4800400	2.267472	.056687	6.72E-01
60	1.5008	7	2	2,2',3,3',4,4',5	.0076	1607970	2.154406	.029484	1.77E-01
61	1.5184	8	3	2,2',3,3',4,5,5',6'	.0025	908635	2.588541	.006451	5.37E-02
62	1.5249	8	3	2,2',3,3',4,5,5',6	.0013	273987	2.173444	.002825	2.35E-02
63	1.5429	8	3	2,2',3,3',4,4',5,6'	.0020	430449	2.249089	.004498	3.74E-02
64	1.5550	8	3	2,2',3,4,4',5,5',6	.0025	594873	2.678887	.006572	5.47E-02
65	1.5920	8	3	2,2',3,3',4,4',5,6	.0016	245830	1.386963	.002219	1.84E-02
68	1.7129	8	2	2,2',3,3',4,4',5,5'	.0011	617523	1.782745	.001961	1.63E-02

Total